



IEC 61784-5-2

Edition 1.0 2007-12

INTERNATIONAL STANDARD

**Industrial communication networks – Profiles –
Part 5-2: Installation of fieldbuses – Installation profiles for CPF 2**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XG**

ICS 35.100.05 25.040.40

ISBN 2-8318-9402-6

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	12
2 Normative references	12
3 Terms, definitions and abbreviated terms	12
4 CPF 2: Overview of installation profiles	12
5 Installation profile conventions	13
6 Conformance to installation profiles.....	13
Annex A (normative) CP 2/1 (ControlNet™) specific installation profile.....	14
A.1 Installation profile scope.....	14
A.2 Normative references	14
A.3 Installation profile terms, definitions, and abbreviated terms.....	14
A.3.1 Terms and definitions	14
A.3.2 Abbreviated terms	14
A.3.3 Conventions for installation profiles	14
A.4 Installation planning	15
A.4.1 Introduction	15
A.4.2 Planning requirements.....	16
A.4.3 Network capabilities	17
A.4.4 Selection and use of cabling components.....	22
A.4.5 Cabling planning documentation	38
A.4.6 Verification of planning specifications.....	38
A.5 Installation implementation.....	39
A.5.1 General requirements.....	39
A.5.2 Cable installation.....	39
A.5.3 Connector installation.....	40
A.5.4 Terminator installation.....	49
A.5.5 Device installation.....	49
A.5.6 Coding and labelling.....	51
A.5.7 Earthing and bonding of equipment and devices and shield cabling.....	51
A.5.8 As implemented cabling documentation.....	52
A.6 Installation verification and installation acceptance test.....	53
A.6.1 Introduction	53
A.6.2 Installation verification.....	53
A.6.3 Installation acceptance test	55
A.7 Installation administration.....	57
A.8 Installation maintenance and installation troubleshooting	57
A.8.1 General	57
A.8.2 Maintenance.....	57
A.8.3 Troubleshooting.....	57
Annex B (normative) CP 2/2 (EtherNet/IP™) specific installation profile.....	62
B.1 Installation profile scope.....	62
B.2 Normative references	62
B.3 Installation profile terms, definitions, and abbreviated terms.....	62
B.3.1 Terms and definitions	62
B.3.2 Abbreviated terms	62

B.3.3	Conventions for installation profiles	63
B.4	Installation planning	63
B.4.1	Introduction	63
B.4.2	Planning requirements	64
B.4.3	Network capabilities	64
B.4.4	Selection and use of cabling components	66
B.4.5	Cabling planning documentation	78
B.4.6	Verification of cabling planning specification	78
B.5	Installation implementation	79
B.5.1	General requirements	79
B.5.2	Cable installation	79
B.5.3	Connector installation	80
B.5.4	Terminator installation	81
B.5.5	Device installation	81
B.5.6	Coding and labelling	81
B.5.7	Earthing and bonding of equipment and devices and shield cabling	81
B.5.8	As-implemented cabling documentation	83
B.6	Installation verification and installation acceptance test	84
B.6.1	Introduction	84
B.6.2	Installation verification	84
B.6.3	Installation acceptance test	85
B.7	Installation administration	86
B.8	Installation maintenance and installation troubleshooting	86
Annex C (normative)	CP 2/3 (DeviceNet™) specific installation profile	87
C.1	Installation profile scope	87
C.2	Normative references	87
C.3	Installation profile terms, definitions and abbreviated terms	87
C.3.1	Terms and definitions	87
C.3.2	Abbreviated terms	87
C.3.3	Conventions for installation profiles	87
C.4	Installation planning	88
C.4.1	Introduction	88
C.4.2	Planning requirements	89
C.4.3	Network capabilities	90
C.4.4	Selection and use of cabling components	103
C.4.5	Cabling planning documentation	112
C.4.6	Verification of cabling planning specification	112
C.5	Installation implementation	113
C.5.1	General requirements	113
C.5.2	Cable installation	113
C.5.3	Connector installation	115
C.5.4	Terminator installation	125
C.5.5	Device installation	126
C.5.6	Coding and labelling	129
C.5.7	Earthing and bonding of equipment and devices and shield cabling	129
C.5.8	As-implemented cabling documentation	130
C.6	Installation verification and installation acceptance test	130
C.6.1	Introduction	130
C.6.2	Installation verification	130

C.6.3	Installation acceptance test	133
C.7	Installation administration.....	134
C.8	Installation maintenance and installation troubleshooting	134
C.8.1	General	134
C.8.2	Maintenance.....	134
C.8.3	Troubleshooting.....	134
C.8.4	Specific requirements for maintenance and troubleshooting	134
Annex D (informative)	Additional information	137
D.1	Network validation check sheet for CP 2/3 (DeviceNet)	137
Bibliography	141

Table A.1	– Basic network characteristics for copper cabling not based on Ethernet (ISO/IEC 8802-3).....	21
Table A.2	– Allowable fibre lengths	21
Table A.3	– Power budgets for ControlNet fibre networks	21
Table A.4	– RG6 coaxial electrical properties.....	22
Table A.5	– RG6 coaxial physical parameters	23
Table A.6	– Cable type selection.....	23
Table A.7	– Information relevant to optical fibre cables	24
Table A.8	– Copper connectors for ControlNet.....	25
Table A.9	– Fibre connectors for fieldbus systems	25
Table A.10	– Separation from other circuits inside enclosures	34
Table A.11	– Pulling and bend radius for coaxial cables	39
Table A.12	– Bend radius for coaxial cables	39
Table A.13	– Spacing from other circuits inside and outside wire ways or conduit.....	40
Table A.14	– Separation from Category 1 conductors for coax cables inside enclosures.....	40
Table A.15	– Test matrix for BNC/TNC connectors.....	54
Table A.16	– Wave length and fibre types	57
Table A.17	– LED status table	59
Table A.18	– Repeater adapter and module diagnostic	59
Table A.19	– Repeater adapter indicator diagnostic	59
Table A.20	– Repeater module indicator	60
Table A.21	– Short and medium distance troubleshooting chart	60
Table A.22	– Long and extra long troubleshooting chart.....	61
Table B.1	– Network characteristics for balanced cabling based on Ethernet	65
Table B.2	– Network characteristics for optical fibre cabling.....	66
Table B.3	– Information relevant to balanced cable: fixed cables	66
Table B.4	– Information relevant to balanced cable: cords	67
Table B.5	– TCL limits for unshielded twisted-pair cabling	67
Table B.6	– ELTCTL limits for unshielded twisted-pair cabling	68
Table B.7	– Coupling attenuation limits for screened twisted-pair cabling.....	68
Table B.8	– 4 pair colour codes and pair assignment	68
Table B.9	– 2 pair colour codes and pair assignment	68
Table B.10	– Fibre type and bandwidth	69

Table B.11 – Connectors for balanced cabling CPs based on Ethernet	69
Table B.12 – Industrial EtherNet/IP 8-way modular connector parameters	70
Table B.13 – Industrial EtherNet/IP M12-4 D-coding connector parameters	71
Table B.14 – Optical fibre connectors for fieldbus systems	71
Table B.15 – Supported fibre types	72
Table B.16 – Connector insertion loss	73
Table B.17 – Routing communications cabling in contiguous metallic pathways	77
Table B.18 – Parameters for balanced cables	79
Table B.19 – Parameters for silica optical fibre cables	79
Table C.1 – Basic network characteristics for copper cabling not based on Ethernet (ISO/IEC-8802-3)	91
Table C.2 – Cable trunk and drop lengths for CP 2/3	91
Table C.3 – Summary of available current for trunk cables (CP 2/3)	95
Table C.4 – Available current for thin cable drop lines	95
Table C.5 – Power supply specification for DeviceNet	96
Table C.6 – Power supply tolerance stack up for DeviceNet	96
Table C.7 – Current versus cable length for one power supply thick cable	98
Table C.8 – Current versus length for two power supplies	99
Table C.9 – Definition of equation variables	101
Table C.10 – Information relevant to copper cable: fieldbus	104
Table C.11 – Information relevant to copper cable: control	104
Table C.12 – DeviceNet cables and connector support cross reference	104
Table C.13 – DeviceNet cable profiles	105
Table C.14 – Copper connectors for non-Ethernet based fieldbus	108
Table C.15 – Additional connectors for CP 2/3 (DeviceNet)	108
Table C.16 – Parameters for balanced cables	113
Table C.17 – Wire colour code and function	118
Table C.18 – Auxiliary power cable colour code	123
Table C.19 – Network power supply requirements	123
Table C.20 – Signal wire verification	131
Table C.21 – Shield to earth	132
Table C.22 – Connector pin out	133
Figure 1 – Standards relationships	11
Figure A.1 – Interconnection of CPF 2 networks	15
Figure A.2 – Overview of CPF 2 networks	16
Figure A.3 – Drop cable requirements	17
Figure A.4 – Placement of BNC/TNC plugs	18
Figure A.5 – Placement of terminators	18
Figure A.6 – Extending a network using repeaters	19
Figure A.7 – Extending a network using active star topology	19
Figure A.8 – Links	20
Figure A.9 – Extending the network beyond 99 nodes	20

Figure A.10 – Maximum allowable taps per segment.....	26
Figure A.11 – Example of repeaters in star configuration	28
Figure A.12 – Repeater in parallel.....	29
Figure A.13 – Repeater in combination series and parallel	29
Figure A.14 – Ring repeater.....	30
Figure A.15 – Installing bulkheads	31
Figure A.16 – Coaxial BNC and TNC terminators	32
Figure A.17 – Terminator placement in a segment	32
Figure A.18 – Redundant network icons.....	35
Figure A.19 – Redundant coax media	35
Figure A.20 – Redundant fibre media.....	35
Figure A.21 – Repeater in series versus length difference for coax media.....	36
Figure A.22 – Repeater in series versus length difference for fibre media	36
Figure A.23 – Example of redundant coax network with repeaters.....	37
Figure A.24 – Example of improper redundant node connection.....	37
Figure A.25 – Example tool kit for installing BNC connectors	41
Figure A.26 – Calibration of coaxial stripper.....	41
Figure A.27 – Coax PVC strip length detail	42
Figure A.28 – Memory cartridge and blade.....	43
Figure A.29 – Cable position.....	43
Figure A.30 – Locking the cable.....	43
Figure A.31 – Stripping the cable.....	44
Figure A.32 – Install the crimp ferrule	44
Figure A.33 – Cable preparation for PVC type cables	44
Figure A.34 – Cable preparation for FR type cables.....	45
Figure A.35 – Strip guides	45
Figure A.36 – Using the flare tool.....	46
Figure A.37 – Expanding the shields.....	46
Figure A.38 – Install the centre pin	46
Figure A.39 – Crimping the centre pin.....	47
Figure A.40 – Installing the connector body	47
Figure A.41 – Installing the ferrule	47
Figure A.42 – Crimp tool.....	48
Figure A.43 – Sealed IP67 cable.....	48
Figure A.44 – Terminator placement	49
Figure A.45 – Mounting the taps	50
Figure A.46 – Mounting the tap assembly using the universal mounting bracket	50
Figure A.47 – Mounting the tap using tie wraps or screws.....	51
Figure A.48 – Redundant network icons.....	51
Figure A.49 – Network test tool.....	54
Figure A.50 – Shorting the cable to test for continuity	54
Figure A.51 – Testing fibre segments.....	56
Figure A.52 – Multi-fibre backbone cable housing	58

Figure A.53 – Repeater adapter module.....	58
Figure A.54 – Short and medium distance fibre module LEDs	60
Figure A.55 – Long and extra long repeater module LEDs	61
Figure B.1 – Interconnection of CPF 2 networks	63
Figure B.2 – Peer to peer connections	65
Figure B.3 – The 8-way modular sealed jack & plug (plastic housing)	70
Figure B.4 – The 8-way modular sealed jack & plug (metal housing).....	70
Figure B.5 – M12-4 connectors	71
Figure B.6 – Simplex LC connector	72
Figure B.7 – Duplex LC connector	72
Figure B.8 – IP65/IP67 sealed duplex LC connector	72
Figure B.9 – M12-4 to 8-way modular bulkhead	74
Figure B.10 – The 8-way modular sealed jack & plug (plastic housing)	80
Figure B.11 – The 8-way modular sealed jack & plug (metal housing).....	80
Figure B.12 – M12-4 connectors	80
Figure B.13 – Wiring standard (connector back end).....	81
Figure B.14 – Earthing of cable shield	83
Figure B.15 – Open shield example	83
Figure C.1 – Interconnection of CPF 2 networks	88
Figure C.2 – Connection to generic cabling.....	89
Figure C.3 – DeviceNet cable system uses a trunk and line topology.....	90
Figure C.4 – Measuring the trunk length	92
Figure C.5 – Measuring the trunk and drop length.....	92
Figure C.6 – Measuring drop cable in a network with multiports	93
Figure C.7 – Removable device using open style connectors	93
Figure C.8 – Fixed connection using open style connector.....	94
Figure C.9 – Open style connector pin out	94
Figure C.10 – Open style connector pin out 10 position	94
Figure C.11 – Power supply sizing example.....	97
Figure C.12 – Current limit for thick cable for one power supply.....	98
Figure C.13 – Current for thick cable and two power supplies	99
Figure C.14 – Worst case scenario	100
Figure C.15 – Example using the lookup method	100
Figure C.16 – One power supply end connected	102
Figure C.17 – Segmenting power in the power bus	103
Figure C.18 – Segmenting the power bus using power taps	103
Figure C.19 – Thick cable construction	113
Figure C.20 – Mid cable construction	114
Figure C.21 – Thin cable construction.....	114
Figure C.22 – Flat cable construction.....	114
Figure C.23 – Cable preparation	115
Figure C.24 – Connector assembly	115
Figure C.25 – Micro connector pin assignment.....	116

Figure C.26 – Mini connector pin assignment.....	116
Figure C.27 – Preparation of cable end.....	116
Figure C.28 – Shrink wrap installation.....	117
Figure C.29 – Wire preparation.....	117
Figure C.30 – Open-style connector (female).....	117
Figure C.31 – Open style (male plug).....	117
Figure C.32 – Flat cable.....	118
Figure C.33 – Aligning the cable.....	119
Figure C.34 – Closing the assembly.....	119
Figure C.35 – Proper orientation of cable.....	119
Figure C.36 – Locking the assembly.....	119
Figure C.37 – Driving the IDC contacts in to the cable.....	120
Figure C.38 – End cap placement.....	120
Figure C.39 – End cap seated.....	121
Figure C.40 – End cap installation alternate side of cable.....	121
Figure C.41 – Flat cable IDC connectors.....	121
Figure C.42 – Installing the connectors.....	122
Figure C.43 – Cable wiring to open style terminals.....	122
Figure C.44 – Auxiliary power cable profile.....	123
Figure C.45 – Pin out auxiliary power connectors.....	123
Figure C.46 – Sealed terminator.....	125
Figure C.47 – Open-style terminator.....	126
Figure C.48 – Open-style IDC terminator.....	126
Figure C.49 – Sealed terminator IDC cable.....	126
Figure C.50 – Direct connection to the trunk.....	127
Figure C.51 – Wiring of open-style connector.....	127
Figure C.52 – Wiring of open-style 10-position connector.....	127
Figure C.53 – Diagnostic temporary connections.....	128
Figure C.54 – Thick cable preterminated cables (cord sets).....	128
Figure C.55 – Thin cable preterminated cables (cord sets).....	129

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES

Part 5-2: Installation of fieldbuses – Installation profiles for CPF 2

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC 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 interpretation 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 61784-5-2 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial process measurement, control and automation.

This standard is to be used in conjunction with IEC 61918:2007.

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

FDIS	Report on voting
65C/471/FDIS	65C/482/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 the 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 maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

Currently in preview, click buy full version

INTRODUCTION

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

IEC 61918:2007 (Ed. 1.0) 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/TR 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 (e.g. IEC 61784-5-2 for CPF 2), allows readers to work with standards of a convenient size.

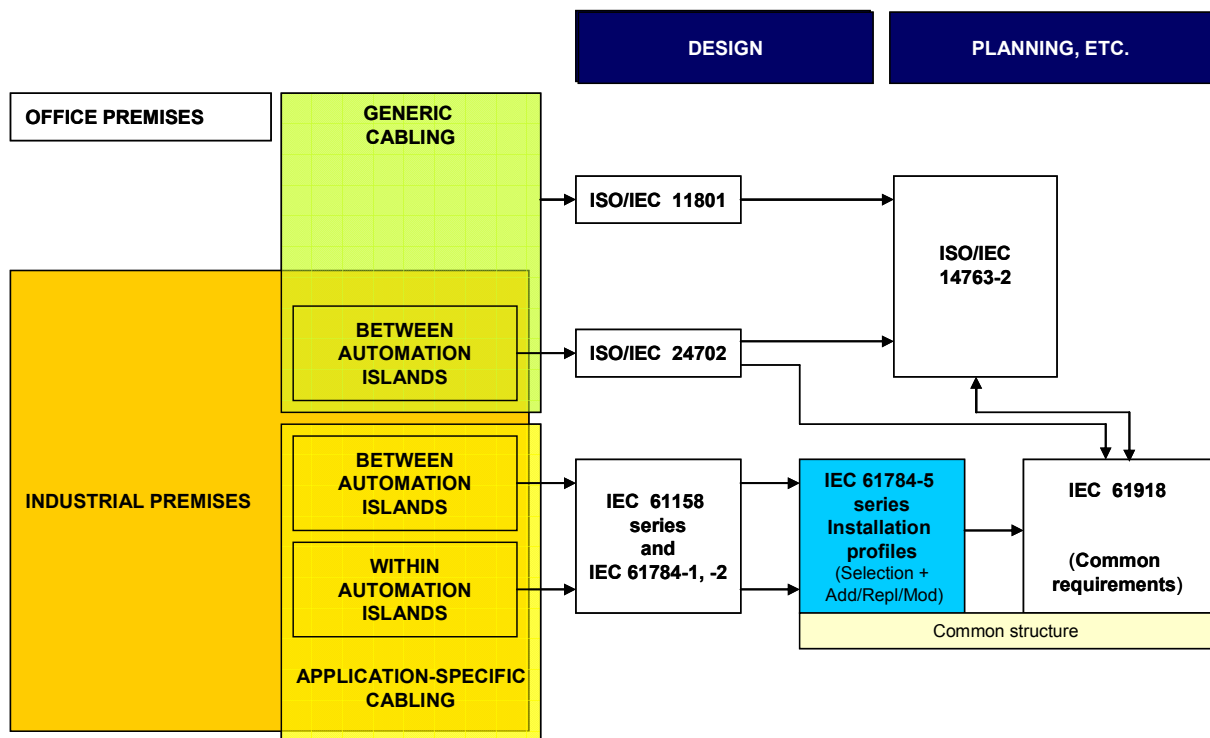


Figure 1 – Standards relationships

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES

Part 5-2: Installation of fieldbuses – Installation profiles for CPF 2

1 Scope

This part of IEC 61784 specifies the installation profiles for CPF 2 (CIP™¹).

The installation profiles are specified in the annexes. These annexes are read in conjunction with IEC 61918:2007.

2 Normative references

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

IEC 61918:2007, *Industrial communication networks – Installation of communication networks in industrial premises*

The normative references of IEC 61918:2007, Clause 2, apply. For profile specific normative references, see Clauses A.2, B.2, and C.2.

¹ CIP™ (Common Industrial Protocol) is a trade name of Open DeviceNet Vendor Association, Inc. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance to this standard does not require use of the trade name CIP™. Use of the trade name CIP™ requires permission of Open DeviceNet Vendor Association, Inc.