IEC 61784-1-5

Edition 1.0 2023-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial networks – Profiles –
Part 1-5: Fieldbus profiles – Communication Profile Family 5

Réseaux industriels – Profils –
Partie 1-5: Profils de bus de terrain – Famille de profils de communication 5

IEC 61784-1-5:2023-03(en-fr)

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Communication Profile Family 5**

FOREWORD

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

IEC 61784-1-5 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This first edition, together with the other parts of the same series, cancels and replaces the fifth edition of IEC 61784-1 published in 2019. This first edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61784-1:2019:

a) split of the original IEC 61784-1 into several subparts, one subpart for the material of a generic nature, and one subpart for each Communication Profile Family specified in the original document.

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

Draft	Report on voting
65C/1207/FDIS	65C/1236/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 61784-1 series, published under the general title *Industrial networks – Profiles – Part 1: Fieldbus profiles*, can be found on the IEC website.

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

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• withdrawn,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

INTRODUCTION

The IEC 61784-1 series provides a set of Communication Profiles (CP) in the sense of ISO/IEC TR 10000-1. These answer the need of identifying the protocol families co-existing within the IEC 61158 series, as a result of the international harmonization of fieldbus technologies available on the market. More specifically, these profiles help to correctly state the compliance with the IEC 61158 series, and to avoid the spreading of divergent implementations, which would limit its use, clearness and understanding. Additional profiles to address specific market concerns, such as functional safety or information security, can be addressed by future parts of the IEC 61784-1 series.

The IEC 61784-1 series contains several Communication Profile Families (CPF), which specify one or more communication profiles. Such profiles identify, in a strict sense, protocol subsets of the IEC 61158 series via protocol specific communication profiles. They do not define device profiles that specify communication profiles together with application functions needed to answer the need of a specific application ("application profiles").

It is agreed that these latter classes of profiles would facilitate the use of the IEC 61158 series of standards; the profiles defined in the IEC 61784-1 series are a necessary step to achieve that task.

It is also important to clarify that interoperability – defined as the ability of two or more network systems to exchange information and to make mutual use of the information that has been exchanged (see ISO/IEC TR 10000-1) – can be directly achieved on the same link only for those devices complying with the same communication profile.

Profiles contained in the IEC 61784-1 series are constructed of references to IEC 61158-2 and the IEC 61158-3, IEC 61158-4, IEC 61158-5 and IEC 61158-6 series, and other IS, TS or worldwide-accepted standards, as appropriate[1]. Each profile is required to reference at least one part of the IEC 61158 series in addition to IEC 61158-1.

Two or more Profiles, which are related to a common family, are specified within a "Communication Profile Family" (CPF).

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[1] International Standardised Profiles may contain normative references to specifications other than International Standards; see ISO/IEC JTC 1 N 4047: *The Normative Referencing of Specifications other than International Standards in JTC 1 International Standardized Profiles – Guidelines for ISP Submitters*.

**INDUSTRIAL NETWORKS –
PROFILES –**

**Part 1-5: Fieldbus profiles –
Communication Profile Family 5**

1 Scope

This part of IEC 61784-1 defines Communication Profile Family 5 (CPF 5). CPF 5 specifies a set of protocol specific communication profiles (CPs) based on the IEC 61158 series (Type 7) and other standards, to be used in the design of devices involved in communications in factory manufacturing and process control.

NOTE   All CPs are based on standards or draft standards or International Standards published by the IEC or on standards or International Standards established by other standards bodies or open standards processes.

Each CP selects an appropriate consistent and compatible subset of services and protocols from the relevant set that is defined and modelled in the IEC 61158 series. For the selected subset of services and protocols, the profile also describes any possible or necessary constraints in parameter values.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE   All parts of the IEC 61158 series, as well as the IEC 61784-1 series and the IEC 61784-2 series are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

IEC 61158-2:2023, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-3-7:2007, *Industrial communication networks – Fieldbus specifications – Part 3-7: Data-link layer service definition – Type 7 elements*

IEC 61158-4-7:2007, *Industrial communication networks – Fieldbus specifications – Part 4-7: Data-link layer protocol specification – Type 7 elements*

IEC 61158-5-7:2007, *Industrial communication networks – Fieldbus specifications – Part 5-7: Application layer service definition – Type 7 element*s

IEC 61158-6-7:2007, *Industrial communication networks – Fieldbus specifications – Part 6-7: Application layer protocol specification – Type 7 elements*

IEC 61784-1-0:2023, *Industrial networks – Profiles – Part 1-0: Fieldbus profiles – General concepts and terminology*

IEC 61784-1-1:2023, *Industrial networks – Profiles – Part 1-1: Fieldbus profiles – Communication Profile Family 1*

IETF RFC 791, J. Postel, *Internet Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc791 [viewed 2022-02-18]

IETF RFC 793, J. Postel, *Transmission Control Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc793 [viewed 2022-02-18]

3 Terms, definitions, abbreviated terms, symbols, and conventions

3.1 Terms and definitions

For the purposes of this document, all terms and definitions provided in the IEC 61158 series and IEC 61784-1-0 apply.

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

• IEC Electropedia: available at https://www.electropedia.org/

• ISO Online browsing platform: available at https://www.iso.org/obp

3.2 Abbreviations and symbols

3.2.1 Common abbreviations and symbols

For the purposes of this document, all abbreviations and symbols defined in the IEC 61158 series and IEC 61784-1-0 apply.

CP   communication profile

CPF   communication profile family

MAU   medium attachment unit

3.2.2 Other abbreviations and symbols

IP   internet protocol (see IETF RFC 791)

TCP   terminal control protocol (see IETF RFC 793)

3.3 Conventions

For the purposes of this document, the conventions defined in IEC 61784-1-0 apply.

4 CPF 5 (WorldFIP®[2])

4.1 General overview

The WorldFIP network is a very flexible and versatile transmission system. The range of functions and performances permit the definition of a large number of profiles to match exactly the requirements of the applications. As a practical approach, the three most popular profiles are developed in this document; they address both time critical context and mission critical functions. Other profiles will be defined for purpose specific application by selecting the appropriate services and protocols in the IEC 61158 series, but respecting the minimum core which is necessary to set up, operate and monitor the network.

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[2] WorldFIP is the trade name of ALSTOM company. 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 with this profile does not require use of the registered trade name. Use of the trade names requires permission of the trade name holder.

All the terms are defined in the base standards: IEC 61158-2, IEC 61158-3-7, IEC 61158-4-7, IEC 61158-5-7 and IEC 61158-6-7.

All the defined profiles are composed of a selection of services and protocols from the IEC 61158 series, Type 7, and tuned by a selection of particular parameters within each service or protocol.

All the WorldFIP profiles are based on a common core set of services of MPS, to which is added an appropriated selection of services providing one or more selected appropriated features.

Table 1 summarizes the element selection of the relative profiles.

Table 1 – CPF 5: overview of profile sets

	Profile 5/1	Profile 5/2	Profile 5/3
Application	(MPS, MCS) of IEC 61158-5-7, IEC 61158-6-7	(MPS, MCS, SubMMS) of IEC 61158-5-7, IEC 61158-6-7	(MPS) of IEC 61158-5-7, IEC 61158-6-7
Data-link	IEC 61158-3-7, IEC 61158-4-7	IEC 61158-3-7, IEC 61158-4-7	IEC 61158-3-7, IEC 61158-4-7
Physical	Type 1 of IEC 61158-2	Type 1 of IEC 61158-2	Type 1 of IEC 61158-2

The selection defined in Table 1 represents the most frequently basic used profiles.

The distinctive features of the different profiles in the basic version are the following:

– Profile 5/1, long messages, wide network topology, loose time-critical purpose-built application layer;
– Profile 5/2, large messages, tight time-critical exchanges, mission-critical application, IEC 61158-5-7 and IEC 61158-6-7 (application layer);
– Profile 5/3, open WorldFIP interface for other purpose-built or standardized tight time-critical application layers (segmented or not).

NOTE   See Annex A for an overview of WorldFIP communications concepts.

It should be emphasized that profile 5/3 may be fitted with web type upper stack profile containing TCP/IP, BSD sockets, HTTP over DLL access point. The addition of this side stack does not impact the profile definition. This important feature permits a TRANSPARENT access of Fieldbus device from remote browser, as long as the field devices implement an EMBEDDED SERVER. This is an additional integration provided by the profiles to federate intelligent Field device into distributed Control Systems.

The physical layers indicated in this document are those relative to the selected profiles. But variants may be defined in the future, using other WorldFIP approved physical layer options for further applications such as high speed radio or very high speed on fiber or copper.

4.2   CP 5/1 (WorldFIP)

4.2.1   Physical layer

Table 2 specifies the physical layer profile within IEC 61158-2. It is common to all of the CPF 5 profiles.

Table 2 – CPF 5: PhL selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	Partial	Used if needed
3	Terms and definitions	—	—
3.1	Common terms and definitions	Partial	Used when applicable
3.2	Type 1: Terms and definitions	YES	—
Next subclauses	—	NO	—
4	Symbols and abbreviated terms	—	—
4.1	Symbols	—	—
4.1.1	Type 1: Symbols	YES	—
Next subclauses	—	NO	—
4.2	Abbreviated terms	—	—
4.2.1	Type 1: Additional abbreviations	YES	—
Next subclauses	—	NO	—
5	Data-link layer – Physical Layer interface	—	—
5.1	General	Partial	Used as needed
5.2	Type 1: Required services	YES	—
Next subclauses	—	NO	—
6	Station Management – Physical Layer interface	—	—
6.1	General	Partial	Used as needed
6.2	Type 1: Station Management – Physical Layer interface	Partial	Used as needed
Next subclauses	—	NO	—
7	DCE Independent Sublayer (DIS)	—	—
7.1	General	Partial	Used as needed
7.2	Type 1: DIS	YES	—
Next subclauses	—	NO	—
8	DTE – DCE interface	NO	—
9	Medium Dependent Sublayer (MDS)	NO	—
10	MDS – MAU interface	—	—
10.1	General	Partial	Used as needed
10.2	Type 1: MDS – MAU interface: wire and optical media	Partial	Used as appropriate
Next subclauses	—	NO	—
11	Type 1 and 7: Medium Attachment Unit: voltage mode, linear-bus-topology 150 Ω twisted-pair wire medium	Partial	See Note
12	Type 1 and 3: Medium Attachment Unit: 31,25 kbit/s, voltage-mode with low-power option, bus- and tree-topology, 100 Ω wire medium	YES	See Note
13 – 14	—	NO	—
15	Type 1 and 7: Medium Attachment Unit: dual-fiber optical media	YES	See Note
16 – 20	—	NO	—

Clause	Header	Presence	Constraints
21	Type 3: Medium Attachment Unit: Synchronous transmission, 31,25 kbit/s, voltage mode, wire medium	YES	See Note
Next clauses	—	NO	—
Annex A	Type 1: Connector specification	—	—
A.1	Internal Connector for wire medium	YES	See Note
A.2	External Connectors for wire medium	YES	See Note
A.3	External Connectors for optical medium	YES	See Note
Annex B	Type 1: Cable specifications and trunk and spur lengths for the 31,25 kbit/s voltage-mode MAU	YES	See Note
Annex C	Type 1: Optical passive stars	YES	See Note
Annex D	Type 1: Star topology	YES	See Note
Annex E	Type 1: Alternate fibers	YES	See Note
Next annexes		NO	—
NOTE The selection could be an alternate solution for the specified profile.			

4.2.2   Data-link layer

4.2.2.1   DLL service selection

Table 3 specifies the DLL service selection within IEC 61158-3-7 for this profile. It is common to all of the CPF 5 profiles.

Table 3 – CPF 5: DLL service selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	Partial	Used as needed
3	Terms, definitions, symbols, abbreviations and conventions	Partial	Used as needed
4	Data-link layer services and concepts	Partial	See Table 4

Table 4 – CPF 5: DLL service selection of Clause 4

Clause	Header	Presence	Constraints
4.1	Field of application, object	YES	—
4.2	General description of services	YES	—
4.3	Sequences of primitives	YES	—
4.4	Buffer writing	YES	See Note 1
4.5	Buffer reading	YES	See Note 1
4.6	Buffer transfer	YES	—
4.7	Explicit request for buffer transfer	Partial	See Note 2
4.8	Unacknowledged message transfer	Partial	See Note 3
4.9	Acknowledged message transfer	Partial	See Note 3
NOTE 1 The maximum length of exchanged DLS-user-data can be either 120 or 128 bytes.			
NOTE 2 The two update services are each optional.			
NOTE 3 The service is optional. When implemented, the maximum length of exchanged DLS-user-data can be either 122 bytes or 256 bytes.			

4.2.2.2   DLL protocol selection

Table 5 specifies the DLL protocol selection within IEC 61158-4-7 for this profile. It is common to all of the CPF 5 profiles.

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Table 5 – CPF 5: DLL protocol selection

IEC 61784-1-5:2023
https://standards.iteh.ai/catalog/standards/sist/99198fc-e7b3-43cc-ac1c-6365/6119aa0/iec-
61784-1-5-2023

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	Partial	Used as needed
3	Terms, definitions, symbols and abbreviations	Partial	Used as needed
4	Overview of the DL-protocol	YES	See Table 6 for a list of mandatory and optional variables and resources
5	General structure and encoding of PhIDUs and DLPDUs and related elements of procedure	YES	See Table 7 for a list of mandatory and optional DLPDUs
6	DLPDU-specific structure, encoding and element of procedure	YES	—
7	DL-service elements of procedure, interfaces and conformance	YES	—
Annex A	Exemplary FCS implementations	YES	—
Annex B	Object modeling	YES	—
Annex C	Topology of multi-segment DL-subnetwork	YES	—
Annex D	Management of transmission errors	YES	—

Table 6 – CPF 5: DLL protocol selection of variables and resources

Clause	Variable or resource name	Usage	Constraints
4.2.1	B_DATprod	M	—
4.2.1	B_REQ	O	—
4.2.1	Q_MSGcyc	O	—
4.2.1	RQ	O	—
4.2.1	PR	O	—
4.2.1	RQ_INHIBIT	O	—
4.2.1	B_DATcons	M	—
4.2.1	Q_MSGaper	O	—
4.2.1	Q_MSGrec	O	—
4.2.1	Q_REQ1	O	—
4.2.1	Q_REQ2	O	—
4.2.2	Q_IDRQ1	O	—
4.2.2	Q_IDRQ2	O	—
4.2.2	Q_RPRQ	O	—
4.2.2	Q_IDMSG	O	—

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Table 7 – CPF 5: DLL protocol selection of DLPDUs

Clause	DLPDU name	Usage	Constraints
5.5.1	ID_DAT	M	—
5.5.1	ID_MSG	O	—
5.5.1	ID_RQ1	O	See Note
5.5.1	ID_RQ2	O	See Note
5.5.2	RP_DAT	M	See Note
5.5.2	RP_DAT_MSG	O	See Note
5.5.2	RP_DAT_RQ1	O	See Note
5.5.2	RP_DAT_RQ2	O	See Note
5.5.2	RP_DAT_RQ1_MSG	O	See Note
5.5.2	RP_DAT_RQ2_MSG	O	See Note
5.5.4	RP_MSG_ACK	O	See Note
5.5.4	RP_MSG_NOACK	O	See Note
5.5.5	RP_ACK+	O	—
5.5.5	RP_ACK-	O	—
5.5.3	RP_RQ1	O	—
5.5.3	RP_RQ2	O	—
5.5.6	RP_END	O	—
NOTE The need for this DLPDU is implementation dependent.			