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

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

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

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INDUSTRIAL NETWORKS – PROFILES –

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

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

IEC 61784-1-1 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.

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- withdrawn,
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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 1-1: Fieldbus profiles – Communication Profile Family 1

1 Scope

This part of IEC 61784-1 defines Communication Profile Family 1 (CPF 1). CPF 1 specifies a set of protocol specific communication profiles (CPs) based on the IEC 61158 series (Type 1, Type 5 and Type 9) 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.

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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.

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

IEC 60079-25, *Explosive atmospheres – Part 25: Intrinsically safe electrical systems*

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 61158-3-1:2014, *Industrial communication networks – Fieldbus specifications – Part 3-1: Data-link layer service definition – Type 1 elements*

IEC 61158-4-1:2014, *Industrial communication networks – Fieldbus specifications – Part 4-1: Data-link layer protocol specification – Type 1 elements*

IEC 61158-5-5:2014, *Industrial communication networks – Fieldbus specifications – Part 5-5: Application layer service definition – Type 5 elements*

IEC 61158-5-9:2014, *Industrial communication networks – Fieldbus specifications – Part 5-9: Application layer service definition – Type 9 elements*

IEC 61158-6-5:2014, *Industrial communication networks – Fieldbus specifications – Part 6-5: Application layer protocol specification – Type 5 elements*

IEC 61158-6-9:2014, *Industrial communication networks – Fieldbus specifications – Part 6-9: Application layer protocol specification – Type 9 elements*

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

ISO/IEC 8802-2:1998, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control*

ISO/IEC/IEEE 8802-3, *Telecommunications and exchange between information technology systems – Requirements for local and metropolitan area networks – Part 3: Standard for Ethernet*

ISO/IEC 15802-3[2], *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Common specifications – Part 3: Media Access Control (MAC) Bridges*

IETF RFC 768, J. Postel, *User Datagram Protocol*, August 1980, available at https://www.rfc-editor.org/info/rfc768 [viewed 2022-02-18]

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]

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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

[2] This standard has been withdrawn.

3.2.2 Other abbreviations and symbols

IP internet protocol (see IETF RFC 791)

IS intrinsically safe (as an adjective)
intrinsic safety (as a noun)

TCP terminal control protocol (see IETF RFC 793)

UDP user datagram protocol (see IETF RFC 768)

3.3 Conventions

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

4 CPF 1 (FOUNDATION™ Fieldbus[3])

4.1 General overview

Communication Profile Family 1 defines profiles based on IEC 61158-2, IEC 61158-3-1, IEC 61158-4-1 physical and data-link protocol Type 1, IEC 61158-5-9 and IEC 61158-6-9 application protocol Type 9, and IEC 61158-5-5 and IEC 61158-6-5 application protocol Type 5, and on other standards (see Table 1).

The FOUNDATION Fieldbus family of protocols consists primarily of two distinct protocol sets, known generically (for historical reasons) as H1 and HSE. The H1 profiles are a subset of IEC 61158 Type 1 physical and data-link and Type 9 application services and protocols, and include both wire-media and fiber-media physical layers operating at 31,25 kbit/s. The HSE profiles are based on use of the ISO/IEC/IEEE 8802-3 (Ethernet-like) MAC and physical layers, and on use of standard internet network and transport layer protocols; they use the Type 5 application services and protocols.

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A third profile set has been developed within the FieldComm Group, but is not in current or planned use. It is included in this profile because it provides a migration path to CPF 1 from some of the CPF 5 protocols, and exclusion from this document could inhibit that migration.

Table 1 – CPF 1: overview of profile sets

Layer	Profile 1/1 (H1)	Profile 1/2 (HSE)	Profile 1/3 (H2)
Application	IEC 61158-5-9, IEC 61158-6-9	IEC 61158-5-5, IEC 61158-6-5	IEC 61158-5-9, IEC 61158-6-9
Transport	—	IETF RFC 768, IETF RFC 793	—
Network	—	IETF RFC 791	—
Data-link	IEC 61158-3-1, IEC 61158-4-1	ISO/IEC/IEEE 8802-3, ISO/IEC 8802-2	IEC 61158-3-1, IEC 61158-4-1
Physical	IEC 61158-2, 31,25 kbit/s, primarily Type 1	any of ISO/IEC/IEEE 8802-3	Type 1 of IEC 61158-2

NOTE 1 See Annex A for an overview of FOUNDATION Fieldbus communications concepts.

NOTE 2 Profile CP 1/2 (HSE) supports communications through both local- and wide-area network infrastructures. It is readily obtainable as commercial off-the-shelf (COTS) technology.

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[3] FOUNDATION™ Fieldbus is a trade name of the FieldComm Group. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance with this profile does not require use of the trade name FOUNDATION™ Fieldbus. Use of the trade name FOUNDATION™ Fieldbus requires permission of the trade name holder.

NOTE 3 Profile CP 1/3 (H2) is similar to CP 1/1 (H1), but with a different and more varied selection of physical layer data rates. It provides a migration path for existing CPF 5/1 installations, such that passive media components are unaffected by the migration.

4.2 CP 1/1 (FOUNDATION™ H1)

4.2.1 Physical layer

4.2.1.1 Communicating devices

4.2.1.1.1 Introduction

Table 2 specifies the IEC 61158-2 PhL selection for a communicating device and its MAU(s).

Table 2 – CP 1/1: PhL selection for communicating devices and their MAUs

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	—
4.1.2 – 4.1.11	—	NO	—
4.2	Abbreviated terms	—	—
4.2.1	Type 1: Abbreviations	YES	—
Next subclauses	—	NO	—
5	Data-link layer – Physical Layer interface	—	—
5.1	General	Partial	Used when applicable
5.2	Type 1: Required services	YES	—
Next subclauses	—	NO	—
6	Systems Management – Physical Layer interface	—	—
6.1	General	Partial	Used when applicable
6.2	Type 1: Systems Management – Physical Layer interface	YES	—
Next subclauses	—	NO	—
7	DCE Independent Sublayer (DIS)	—	—
7.1	General	Partial	Used when applicable
7.2	Type 1: DIS	YES	—
Next subclauses	—	NO	—
8	DTE – DCE interface	—	—
8.1	General	Partial	Used when applicable
8.2	Type 1: DTE – DCE interface	YES	—
Next subclauses	—	NO	—

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Clause	Header	Presence	Constraints
9	Medium Dependent Sublayer (MDS)	—	—
9.1	General	Partial	Used when applicable
9.2	Type 1: MDS: Wire and optical media	YES	—
Next subclauses	—	NO	—
10	MDS – MAU interface	—	—
10.1	General	Partial	Used when applicable
10.2	Type 1: MDS – MAU interface: wire and optical media	YES	—
Next subclauses	—	NO	—
11	Type 1 and 7: Medium Attachment Unit: voltage mode, linear-bus-topology 150 Ω twisted-pair wire medium	NO	
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 4.2.1.1.2
13 – 15	—	NO	—
16	Type 1: Medium Attachment Unit: 31,25 kbit/s, single-fiber optical medium	YES	See 4.2.1.1.2
17 – 20	—	NO	—
21	Type 3: Medium Attachment Unit: Synchronous transmission, 31,25 kbit/s, voltage mode, wire medium	YES	See 4.2.1.1.2 (denigrated)
Next clauses	—	NO	—
Annex A	Type 1: Connector specification	—	—
A.1	Internal Connector for wire medium	YES	[a]
A.2	External Connectors for wire medium	YES	[a]
A.3	External Connectors for optical medium	Partial	[b]
Annex B	Type 1: Cable specifications and trunk and spur lengths for the 31,25 kbit/s voltage-mode MAU	YES	—
Annex C	Types 1 and 7: Optical passive stars	Partial	[b]
Annex D	Types 1 and 7: Star topology	Partial	[b]
Annex E	Type 1: Alternate fibers	Partial	[b]
Next annexes	—	NO	—

[a] Connector is optional for use with shielded or twisted-pair 100 Ω wire media.

[b] Single fiber specifications are optional for use with single fiber media.

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4.2.1.1.2 MAU and device classes

Each MAU is classified according to its characteristics when interfacing to its associated medium, as specified in Table 3. For devices with a single attached MAU, whether separate or integral, the MAU class is also considered to be the device class. The selection of the proper clause of IEC 61158-2, Clause 12 or Clause 16, is based on the MAU class for which the MAU, and sometimes the associated device, are designed. The selection of Clause 21 is denigrated – not recommended for new designs – because the alternative clause, Clause 12, permits devices to lower their power consumption during periods of non-transmission.

This profile also lists recommendations, which are not mandatory for implementation and/or not specified in IEC 61158-2, but are included to achieve interoperability amongst devices conforming to this profile. Specifically, 4.2.1.1.3.3 applies to each MAU, as so does 4.2.1.1.3.4 for MAUs meeting IS rules.