# IEC 61784-2-16

Edition 1.0 2023-05

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

## Industrial networks – Profiles – Part 2-16: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 16

## Réseaux industriels – Profils – Partie 2-16: Profils de bus de terrain supplémentaires pour les réseaux en temps réel fondés sur l'ISO/IEC/IEEE 8802-3 – CPF 16



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# CONTENTS

FOREWORD ..... 3
INTRODUCTION ..... 5
1 Scope ..... 6
2 Normative references ..... 6
3 Terms, definitions, abbreviated terms, acronyms, and conventions ..... 7
3.1 Terms and definitions ..... 7
3.2 Abbreviated terms and acronyms ..... 8
3.3 Symbols ..... 8
3.4 Conventions ..... 9
4 CPF 16 (SERCOS) – RTE communication profiles ..... 9
4.1 General overview ..... 9
4.2 CP 16/3 (SERCOS III) ..... 10
4.2.1 Physical layer ..... 10
4.2.2 Data-link layer ..... 10
4.2.3 Application layer ..... 10
4.2.4 Performance indicator selection ..... 11
Bibliography ..... 18

Table 1 – CPF 16 symbols ..... 9
Table 2 – CP 16/3: DLL service selection ..... 10
Table 3 – CP 16/3: DLL protocol selection ..... 10
Table 4 – CP 16/3: AL service selection ..... 10
Table 5 – CP 16/3: AL protocol selection ..... 11
Table 6 – CP 16/3: PI overview ..... 11
Table 7 – CP 16/3: PI dependency matrix ..... 12
Table 8 – CP 16/3: Consistent set of PIs with a minimum cycle time of 31,25 µs ..... 15
Table 9 – CP 16/3: Consistent set of PIs with a cycle time of 500 µs (real-time only) ..... 16
Table 10 – CP 16/3: Consistent set of PIs with a cycle time of 500 µs (real-time and non-real-time) ..... 17
Table 11 – CP 16/3: Consistent set of PIs with non symmetrical data throughput and a cycle time of 500 µs (real-time and non-real-time) ..... 17

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# INDUSTRIAL NETWORKS – PROFILES –

## Part 2-16: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 16

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

IEC 61784-2-16 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 fourth edition of IEC 61784-2 published in 2019. This first edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61784-2:2019:

a) split of the original IEC 61784-2 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/1209/FDIS | 65C/1237/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 61784-2 series, published under the general title *Industrial networks – Profiles – Part 2: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3*, 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 61784-2 series provides additional Communication Profiles (CP) to the existing Communication Profile Families (CPF) of the IEC 61784-1 series and additional CPFs with one or more CPs. These profiles meet the industrial automation market objective of identifying Real-Time Ethernet (RTE) communication networks coexisting with ISO/IEC/IEEE 8802-3 – commonly known as Ethernet. These RTE communication networks use provisions of ISO/IEC/IEEE 8802-3 for the lower communication stack layers and additionally provide more predictable and reliable real-time data transfer and means for support of precise synchronization of automation equipment.

More specifically, these profiles help to correctly state the compliance of RTE communication networks with ISO/IEC/IEEE 8802-3, and to avoid the spreading of divergent implementations.

Adoption of Ethernet technology for industrial communication between controllers and even for communication with field devices promotes the use of Internet technologies in the field area. This availability would be unacceptable if it causes the loss of features required in the field area for industrial communication automation networks, such as:

- real-time,
- synchronized actions between field devices like drives,
- efficient, frequent exchange of very small data records.

These new RTE profiles can take advantage of the improvements of Ethernet networks in terms of transmission bandwidth and network span.

Another implicit but essential requirement is that the typical Ethernet communication capabilities, as used in the office world, are fully retained, so that the software involved remains applicable.

The market is in need of several network solutions, each with different performance characteristics and functional capabilities, matching the diverse application requirements. RTE performance indicators, whose values will be provided with RTE devices based on communication profiles specified in the IEC 61784-2 series, enable the user to match network devices with application-dependent performance requirements of an RTE network.

# INDUSTRIAL NETWORKS – PROFILES –

# Part 2-16: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 16

## 1 Scope

This part of IEC 61784-2 defines extensions of Communication Profile Family 16 (CPF 16) for Real-Time Ethernet (RTE). CPF 16 specifies a Real-Time Ethernet (RTE) communication profile (CP) and related network components based on the IEC 61158 series (Type 19), ISO/IEC/IEEE 8802-3 and other standards.

For each RTE communication profile, this document also specifies the relevant RTE performance indicators and the dependencies between these RTE performance indicators.

NOTE 1 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.

NOTE 2 The RTE communication profile uses ISO/IEC/IEEE 8802-3 communication networks and its related network components and in some cases amend those standards to obtain RTE features.

NOTE 3 Some CPs of CPF 16 are specified in IEC 61784-1-16.

## 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 61158-3-19:2019, *Industrial communication networks – Fieldbus specifications – Part 3-19: Data-link layer service definition – Type 19 elements*

IEC 61158-4-19:2019, *Industrial communication networks – Fieldbus specifications – Part 4-19: Data-link layer protocol specification – Type 19 elements*

IEC 61158-5-19:2019, *Industrial communication networks – Fieldbus specifications – Part 5-19: Application layer service definition – Type 19 elements*

IEC 61158-6-19:2019, *Industrial communication networks – Fieldbus specifications – Part 6-19: Application layer protocol specification – Type 19 elements*

IEC 61784-1-16:2023, *Industrial networks – Profiles – Part 1-16: Fieldbus profiles – Communication Profile Family 16*

IEC 61784-2-0:2023, *Industrial networks – Profiles – Part 2-0: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – General concepts and terminology*

IEC 61800 (all parts), *Adjustable speed electrical power drive systems*

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

IEEE Std 802-2014, *IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*

IEEE Std 802.1AB-2016, *IEEE Standard for Local and metropolitan area networks – Station and Media Access Control Connectivity Discovery*

IEEE Std 802.1AS-2020, *IEEE Standard for Local and Metropolitan Area Networks – Timing and Synchronization for Time-Sensitive Applications*

IEEE Std 802.1Q-2018, *IEEE Standard for Local and Metropolitan Area Networks – Bridges and Bridged Networks*

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 792, J. Postel, *Internet Control Message Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc792 [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, acronyms, and conventions

### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61784-2-0, ISO/IEC/IEEE 8802-3, IEEE Std 802-2014, IEEE Std 802.1AB-2016, IEEE Std 802.1AS-2020, IEEE Std 802.1Q-2018 and the following 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

**3.1.1**
**communication cycle**
fixed time period between two master synchronization telegrams

**3.1.2**
**identification number**
**IDN**
designation of operating data under which a data block is preserved with its attribute, name, unit, minimum and maximum input values, and the data

**3.1.3**
**IP channel**
defined time slot within the communication cycle, which passes ISO/IEC/IEEE 8802-3 Ethernet protocol frames (non-real-time communication)

**3.1.4**
**master**
node which assigns the other nodes the right to transmit

**3.1.5**
**MDT0 telegram**
telegram, in which the master transmits its synchronization data, as well as parts or all of its real-time data, to the slaves

**3.1.6**
**telegram**
frame

### 3.2 Abbreviated terms and acronyms

For the purposes of this document, abbreviated terms and acronyms defined in IEC 61784-2-0 and the following apply.

| | |
|---|---|
| CP | Communication Profile [according to IEC 61784-1-0] |
| CPF | Communication Profile Family [according to IEC 61784-1-0] |
| ICMP | Internet Control Message Protocol (see IETF RFC 792) |
| IDN | IDentification Number |
| IETF | Internet Engineering Task Force |
| IP | Internet Protocol (see IETF RFC 791) |
| LLDP | Link Layer Discovery Protocol (see IEEE Std 802.1AB-2016) |
| Phy | PHY Physical layer entity sublayer (see ISO/IEC/IEEE 8802-3) |
| PI | Performance indicator |
| RSTP | Rapid Spanning Tree Algorithm and Protocol (see IEEE Std 802.1Q-2018) |
| SERCOS | SErial Real time COmmunication System |
| TCP | Transmission Control Protocol (see IETF RFC 793) |
| UDP | User Datagram Protocol (see IETF RFC 768) |

### 3.3 Symbols

For the purposes of this document, symbols defined in IEC 61784-2-0 and Table 1 apply.

NOTE Definitions of symbols in this Subclause 3.3 do not use the italic font, as they are already identified as symbols.

**Table 1 – CPF 16 symbols**

| Symbol | Definition | Unit |
|---|---|---|
| ac | Non-time based synchronization accuracy | ns |
| cd | Cable delay | µs/m |
| clt | Total cable length | m |
| ct | Cycle_time configured for the network segment | µs |
| data | Data to be transmitted in one cycle (including the complete Ethernet frame) | bit |
| DT | Delivery time | µs |
| fr | Frame runtime | µs |
| ma | Synchronization accuracy of the master device | µs |
| mct | Minimum cycle time | ms |
| N | Integer value | – |
| nf | Number of frames | – |
| nn | Number of nodes | – |
| pd | Propagation delay (signal delay) of a forwarding node | µs |
| sa | Synchronization accuracy of one slave device | µs |
| st | Separation time per frame | µs |
| tt | Transfer time | µs |

### 3.4 Conventions

For the purposes of this document, the conventions defined in IEC 61784-2-0 apply.

## 4 CPF 16 (SERCOS[1]) – RTE communication profiles

### 4.1 General overview

Communication Profile Family 16 defines profiles based on IEC 61158 series, protocol Type 16 and Type 19.

The CPF 16 consists of three communication profiles (CP).

– Profile 16/1 (SERCOS I)

  This profile is based on fibre-media physical layers and operates at 2 Mbit/s and 4 Mbit/s. Refer to IEC 61784-1-16.

– Profile 16/2 (SERCOS II)

  This profile is similar to 16/1, but operates also at 8 Mbit/s and 16 Mbit/s, and provides for additional features. Refer to IEC 61784-1-16.

– Profile 16/3 (SERCOS III)

  This profile is based on ISO/IEC/IEEE 8802-3 (Ethernet) MAC and physical layers; it provides again for additional features.

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1 SERCOS is a trade name of Sercos International e.V. 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. Use of the trade name requires permission of the trade name holder.