IEC 61784-3-2

Edition 4.0 2021-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – Profiles – Part 3-2: Functional safety fieldbuses – Additional specifications for CPF 2

Réseaux de communication industriels – Profils – Partie 3-2: Bus de terrain de sécurité fonctionnelle – Spécifications supplémentaires pour CPF 2

IEC 61784-3-2:2021-05(en-fr)

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INTERNATIONAL
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COMMISSION

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ICS 25.040.40; 35.100.05

ISBN 978-2-8322-9747-6

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CONTENTS

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INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

Part 3-2: Functional safety fieldbuses – Additional specifications 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.

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IEC 61784-3-2 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 fourth edition cancels and replaces the third edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- addition of two new Safety Supervisor object states in 6.6.5.5;
- addition of Net LED behaviour requirement for the proposing TUNID process in 6.6.8, 9.1.2 and 9.1.5;
- addition of application path support for process variables in 6.3.9 and 6.3.10;
- addition of multi-port device support in 6.6.4, 6.6.5, 6.6.7 and miscellaneous places;

- correction of network reaction time equations in 9.3.3;
- addition of SIL support up to SIL 3 in 7.6, 8.7, 8.9, 9.5 and miscellaneous places;
- clean up of configuration procedure guidelines in 8.9.14 and 8.9.15;
- switch change detection in 9.1.6;
- deprecation of base format in 3.1.2, 7.1.1.1 and 6.3.3.2;
- fixing Max_Fault_Number value to 2 in 6.3.3.4, 6.8.3 and 8.8.3;
- updated network PFH calculation in 9.5.2;
- miscellaneous minor corrections made since the last publication.

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

FDIS	Report on voting
65C/1083/FDIS	65C/1087/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/standardsdev/publications.

A list of all parts of the IEC 61784-3 series, published under the general title *Industrial communication networks – Profiles – Functional safety fieldbuses*, 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 "http://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.

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.

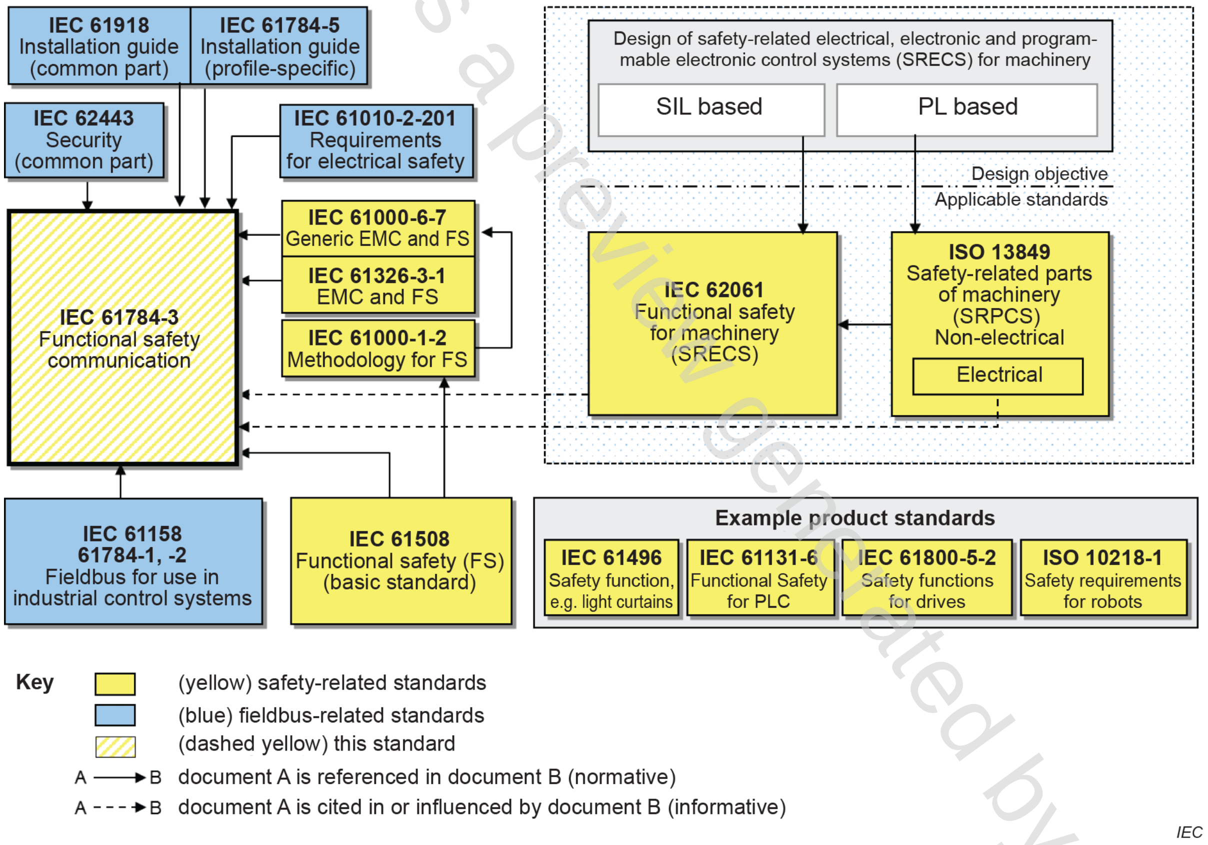
0 Introduction

0.1 General

The IEC 61158 (all parts) fieldbus standard together with its companion standards IEC 61784-1 and IEC 61784-2 defines a set of communication protocols that enable distributed control of automation applications. Fieldbus technology is now considered well accepted and well proven. Thus, fieldbus enhancements continue to emerge, addressing applications for areas such as real time and safety-related applications.

IEC 61784-3 (all parts) explains the relevant principles for functional safety communications with reference to IEC 61508 (all parts) and specifies several safety communication layers (profiles and corresponding protocols) based on the communication profiles and protocol layers of IEC 61784-1, IEC 61784-2 and IEC 61158 (all parts). It does not cover electrical safety and intrinsic safety aspects. It also does not cover security aspects, nor does it provide any requirements for security.

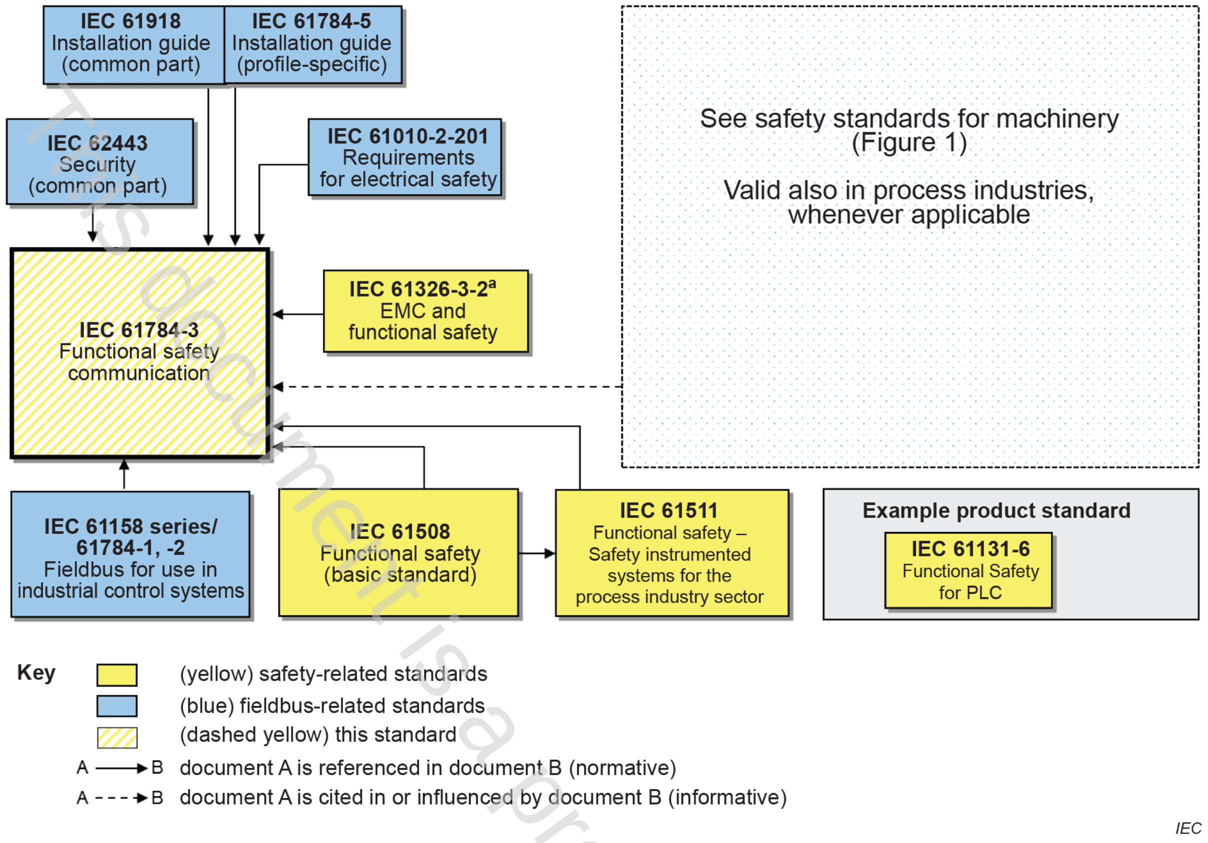
Figure 1 shows the relationships between IEC 61784-3 (all parts) and relevant safety and fieldbus standards in a machinery environment.



NOTE IEC 62061 specifies the relationship between PL (Category) and SIL.

Figure 1 – Relationships of IEC 61784-3 with other standards (machinery)

Figure 2 shows the relationships between IEC 61784-3 (all parts) and relevant safety and fieldbus standards in a process environment.



[a] For specified electromagnetic environments; otherwise IEC 61326-3-1 or IEC 61000-6-7.

Figure 2 – Relationships of IEC 61784-3 with other standards (process)

Safety communication layers which are implemented as parts of safety-related systems according to IEC 61508 (all parts) provide the necessary confidence in the transportation of messages (information) between two or more participants on a fieldbus in a safety-related system, or sufficient confidence of safe behaviour in the event of fieldbus errors or failures.

Safety communication layers specified in IEC 61784-3 (all parts) do this in such a way that a fieldbus can be used for applications requiring functional safety up to the Safety Integrity Level (SIL) specified by its corresponding functional safety communication profile.

The resulting SIL claim of a system depends on the implementation of the selected functional safety communication profile (FSCP) within this system – implementation of a functional safety communication profile in a standard device is not sufficient to qualify it as a safety device.

IEC 61784-3 (all parts) describes:

- basic principles for implementing the requirements of IEC 61508 (all parts) for safety-related data communications, including possible transmission faults, remedial measures and considerations affecting data integrity;
- functional safety communication profiles for several communication profile families in IEC 61784-1 and IEC 61784-2, including safety layer extensions to the communication service and protocols sections of IEC 61158 (all parts).

0.2 Patent declaration

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning the functional safety communication profiles for family 2. IEC takes no position concerning the evidence, validity, and scope of these patent rights.

The holder of these patent rights has assured IEC that s/he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of these patent rights is registered with IEC. Information may be obtained from the patent database available at http://patents.iec.ch.

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INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

Part 3-2: Functional safety fieldbuses – Additional specifications for CPF 2

1 Scope

This part of IEC 61784-3 (all parts) specifies a safety communication layer (services and protocol) based on CPF 2 of IEC 61784-1, IEC 61784-2 and IEC 61158 Type 2. It identifies the principles for functional safety communications defined in IEC 61784-3 that are relevant for this safety communication layer. This safety communication layer is intended for implementation in safety devices only.

NOTE 1 It does not cover electrical safety and intrinsic safety aspects. Electrical safety relates to hazards such as electrical shock. Intrinsic safety relates to hazards associated with potentially explosive atmospheres.

This document defines mechanisms for the transmission of safety-relevant messages among participants within a distributed network using fieldbus technology in accordance with the requirements of IEC 61508 (all parts)[1] for functional safety. These mechanisms may be used in various industrial applications such as process control, manufacturing automation and machinery.

This document provides guidelines for both developers and assessors of compliant devices and systems.

NOTE 2 The resulting SIL claim of a system depends on the implementation of the selected functional safety communication profile within this system – implementation of a functional safety communication profile according to this document in a standard device is not sufficient to qualify it as a safety device.

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.

IEC 61131-2, *Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61131-3, *Programmable controllers – Part 3: Programming languages*

IEC 61158-2:2014, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-3-2, *Industrial communication networks – Fieldbus specifications – Part 3-2: Data-link layer service definition – Type 2 elements*

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

[1] In the following pages of this document, "IEC 61508" will be used for "IEC 61508 (all parts) ".

IEC 61158-4-2:2019, *Industrial communication networks – Fieldbus specifications – Part 4-2: Data-link layer protocol specification – Type 2 elements*

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

IEC 61158-5-2, *Industrial communication networks – Fieldbus specifications – Part 5-2: Application layer service definition – Type 2 elements*

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

IEC 61158-6-2, *Industrial communication networks – Fieldbus specifications – Part 6-2: Application layer protocol specification – Type 2 elements*

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

IEC 61326-3-1, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*

IEC 61326-3-2, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-2: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – Industrial applications with specified electromagnetic environment*

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

IEC 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 61784-2, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC/IEEE 8802-3*

IEC 61784-3:2021, *Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions*

IEC 61784-5-2, *Industrial communication networks – Profiles – Part 5-2: Installation of fieldbuses – Installation profiles for CPF 2*

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

IEC 62026-3, *Low-voltage switchgear and controlgear – Controller-device interfaces (CDIs) – Part 3: DeviceNet*

ISO 13849-1:2015, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 15745-2:2003, *Industrial automation systems and integration – Open systems application integration framework – Part 2: Reference description for ISO 11898-based control systems*

ISO 15745-3:2003, *Industrial automation systems and integration – Open systems application integration framework – Part 3: Reference description for IEC 61158-based control systems*

ISO 15745-4:2003, *Industrial automation systems and integration – Open systems application integration framework – Part 4: Reference description for Ethernet-based control systems*

3 Terms, definitions, symbols, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61784-3 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE Italics are used in the definitions to highlight terms which are themselves defined in 3.1.

3.1.1 Common terms and definitions

NOTE These common terms and definitions are inherited from IEC 61784-3:2021.

3.1.1.1
bit error probability
Pe
probability for a given bit to be received with the incorrect value

3.1.1.2
black channel
defined communication system containing one or more elements without evidence of design or validation according to IEC 61508

Note 1 to entry: This definition expands the usual meaning of channel to include the system that contains the channel.

3.1.1.3
bridge
abstract device that connects multiple network segments along the data link layer

3.1.1.4
closed communication system
fixed number or fixed maximum number of participants linked by a *communication system* with well-known and fixed properties, and where the *risk* of unauthorized access is considered negligible

[SOURCE: IEC 62280:2014, 3.1.6, modified – transmission replaced by communication]

3.1.1.5
communication channel
logical *connection* between two end-points within a *communication system*

3.1.1.6
communication system
arrangement of hardware, software and propagation media to allow the transfer of *messages* (ISO/IEC 7498-1 application layer) from one application to another

3.1.1.7
connection
logical binding between two application objects within the same or different devices