IEC 61784-3-3

Edition 3.0 2016-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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

IEC 61784-3-3:2016-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 25.040.40, 35.100.05

ISBN 978-2-8322-3481-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

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

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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International Standard IEC 61784-3-3 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- Legacy V1-mode removed from this protocol edition;
- Protocol extensions to protect against possible loopbacks (LP extensions);
- Protocol extensions to keep SIL3 for safety networks with large numbers of participants (XP extensions) and subsequent new F-Parameter "F_CRC_Seed";
- Introduction of random and disjoint Codename based MonitoringNumbers (MNR) besides to the previous Consecutive Numbers;

- Provisions for Channel Granular Passivation and subsequent new F-Parameter "F_Passivation";
- GSD extensions due to new F-Parameters;
- Notations according to the CP3 family in IEC 61158 (e.g. IO Controller);
- Additional diagnosis message types;
- Diverse error corrections and fixes of typos;
- Updated documents in bibliography.

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

FDIS	Report on voting
65C/851/FDIS	65C/854/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 61784-3 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 publication will remain unchanged until the stability 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.

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.

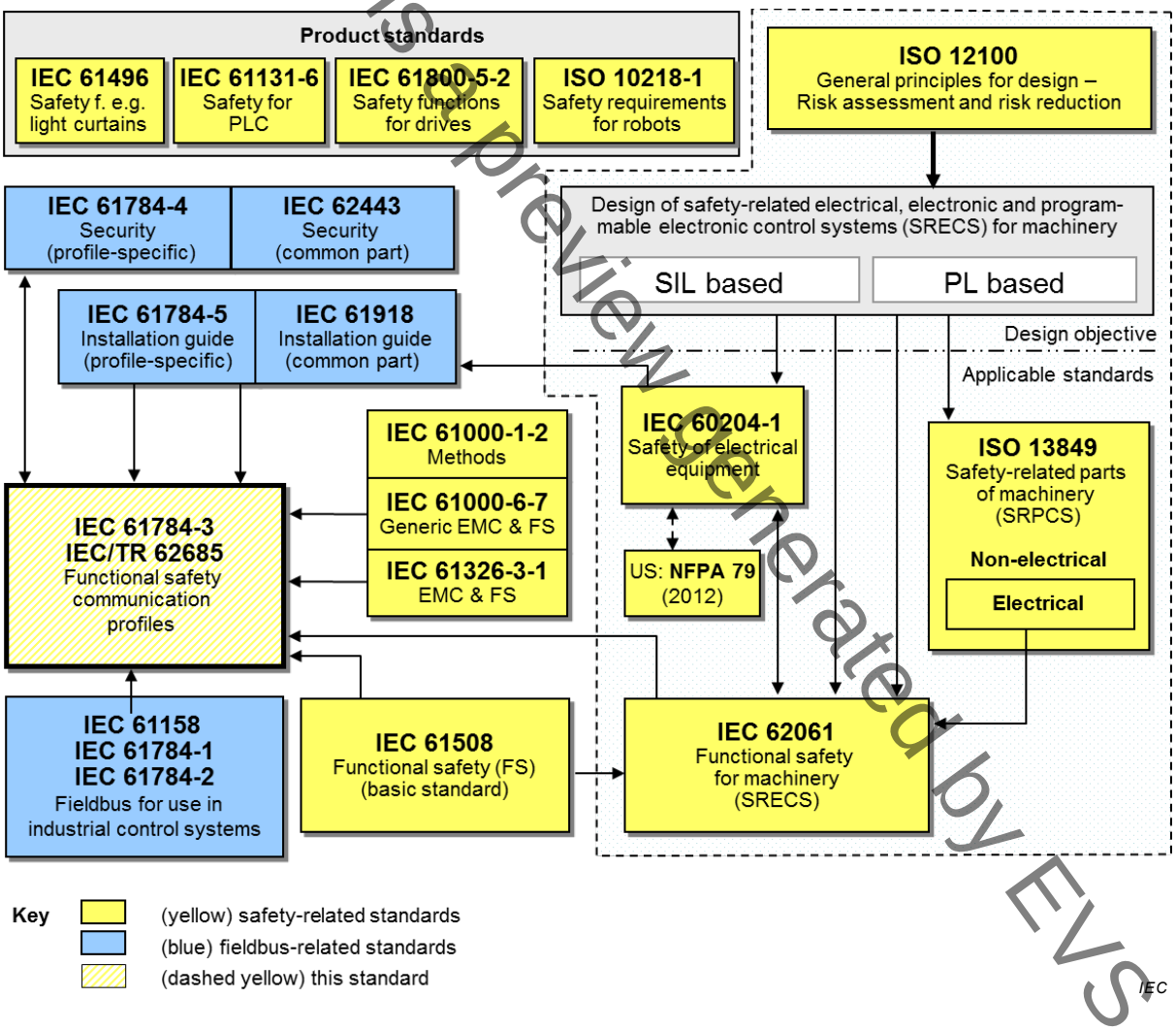
0 Introduction

0.1 General

The IEC 61158 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, safety-related and security-related applications.

This standard explains the relevant principles for functional safety communications with reference to IEC 61508 series 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 the IEC 61158 series. It does not cover electrical safety and intrinsic safety aspects.

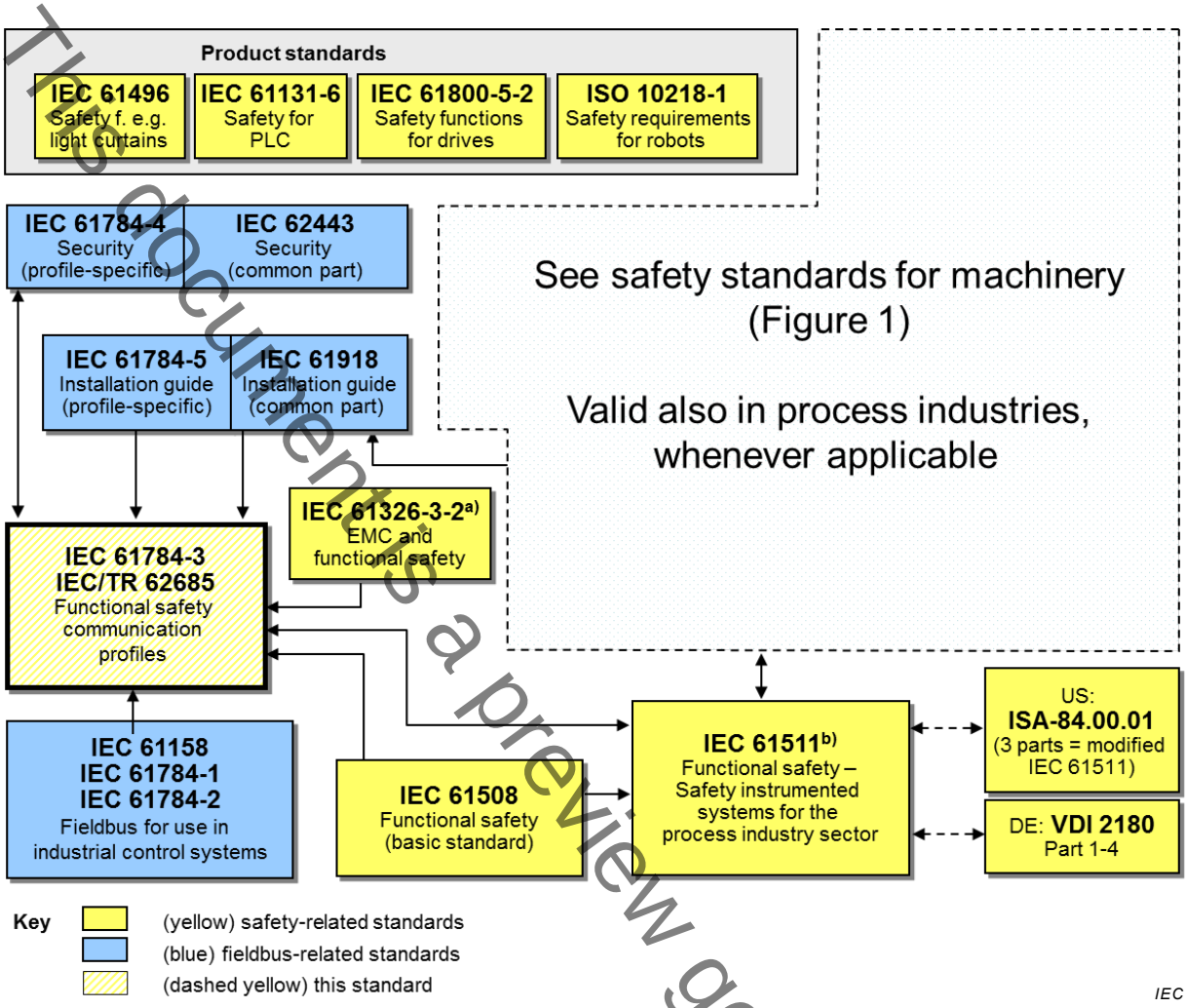
Figure 1 shows the relationships between this standard and relevant safety and fieldbus standards in a machinery environment.



NOTE Subclauses 6.7.6.4 (high complexity) and 6.7.8.1.6 (low complexity) of IEC 62061 specify the relationship between PL (Category) and SIL.

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

Figure 2 shows the relationships between this standard 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.

[b] EN ratified.

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 series 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 this standard 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.

This standard describes:

– basic principles for implementing the requirements of IEC 61508 series 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 the IEC 61158 series.

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 3 as follows, where the [xx] notation indicates the holder of the patent rights:

US 6907542	[SI]	System, device and method for determining the reliability of data carriers in a failsafe system network
US 6725419 DE 59910661.1 EP 1064590	[SI]	Automation system and method for operating an automation system
US 7808917 DE 50 2005 001 819.2 EP 1686732	[SI]	Method and system for transmitting telegrams
US 7640480 DE 50 2005 004 305.7 EP 1802019	[SI]	Detection of errors in the communication of data
EP 1921525	[SI]	Security-related system component e.g. guard door, for automation system of production system, has comparing unit comparing signatures for identity, where component supports security-related operation during sameness of signatures
EP 13172092.2	[SI]	Method and System for Detecting Errors when Transmitting Data from a Transmitter to at Least One Receiver

IEC takes no position concerning the evidence, validity and scope of these patent rights.

The holders of these patents rights have assured the IEC that they are willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with IEC.

Information may be obtained from:

[SI] Siemens Aktiengesellschaft
CT IP M&A
Otto-Hahn-Ring 6
81739 München
GERMANY

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO (www.iso.org/patents) and IEC (http://patents.iec.ch) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

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

1 Scope

This part of the IEC 61784-3 series specifies a safety communication layer (services and protocol) based on CPF 3 of IEC 61784-1, IEC 61784-2 (CP 3/1, CP 3/2, CP 3/4, CP 3/5 and CP 3/6) and IEC 61158 Types 3 and 10. 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 part[1] 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 series[2] for functional safety. These mechanisms may be used in various industrial applications such as process control, manufacturing automation and machinery.

This part 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 part in a standard device is not sufficient to qualify it as a safety device.

2 Normative references

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

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61131-2:2007, *Programmable controllers – Part 2: Equipment requirements and tests*

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

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1 In the following pages of this standard, “this part” will be used for “this part of the IEC 61784-3 series”.

2 In the following pages of this standard, “IEC 61508” will be used for “IEC 61508 series”.

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

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

IEC 61158-4-3, *Industrial communication networks – Fieldbus specifications – Part 4-3: Data-link layer protocol specification – Type 3 elements*

IEC 61158-5-3, *Industrial communication networks – Fieldbus specifications – Part 5-3: Application layer service definition –Type 3 elements*

IEC 61158-5-10, *Industrial communication networks – Fieldbus specifications – Part 5-10: Application layer service definition – Type 10 elements*

IEC 61158-6-3, *Industrial communication networks – Fieldbus specifications – Part 6-3: Application layer protocol specification – Type 3 elements*

IEC 61158-6-10, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 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 61508-2, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*

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 8802-3*

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

IEC 61784-5-3, *Industrial communication networks – Profiles – Part 5-3: Installation of fieldbuses – Installation profiles for CPF 3*

IEC 61918:2013, *Industrial communication networks – Installation of communication networks in industrial premises*

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3 To be published.

IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

IEC 62280:2014, *Railway applications – Communication, signalling and processing systems – Safety-related communication in transmission systems*

IEC TR 62390, *Common automation device – Profile guideline*

ISO 13849-1:2006, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13849-2, *Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

3 Terms, definitions, symbols, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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:—.

3.1.1.1
active network element
network element containing electrically and/or optically active components that allows extension of the network

Note 1 to entry: Examples of active network elements are repeaters and switches.

[SOURCE: IEC 61918:2013, 3.1.2]

3.1.1.2
availability
probability for an automated system that for a given period of time there are no unsatisfactory system conditions such as loss of production

3.1.1.3
bit error probability
Pe
probability for a given bit to be received with the incorrect value

3.1.1.4
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.

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