IEC 61784-3-1

Edition 1.0 2007-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – Profiles – Part 3-1: Functional safety fieldbuses – Additional specifications for CPF 1

Réseaux de communication industriels – Profils – Partie 3-1: Bus de terrain à sécurité fonctionnelle – Spécifications complémentaires pour le CPF 1

IEC 61784-3-1:2007-12(en-fr)

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INDUSTRIAL COMMUNICATION NETWORKS – PROFILES

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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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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 1 as follows, where the [xx] notation indicates the holder of the patent right:

US 6,999,824	[FF]	System and method for implementing safety instrumented systems in a fieldbus architecture

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 under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holders of these patent rights are registered with IEC.

Information may be obtained from:

[FF] Fieldbus Foundation

9005 Mountain Ridge Drive
Bowie Bldg. - Suite 190
Austin, TX 78759-5316
Tel: +1 512 794 8890

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.

International Standard IEC 61784-3-1 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial process measurement, control and automation.

This bilingual version (2014-12) corresponds to the English version, published in 2007-12.

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

FDIS	Report on voting
65C/470/FDIS	65C/481/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.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

The list of all parts of the IEC 61784-3 series, under the general title *Industrial communication networks – Profiles – Functional safety fieldbuses*, can be found on the IEC website.

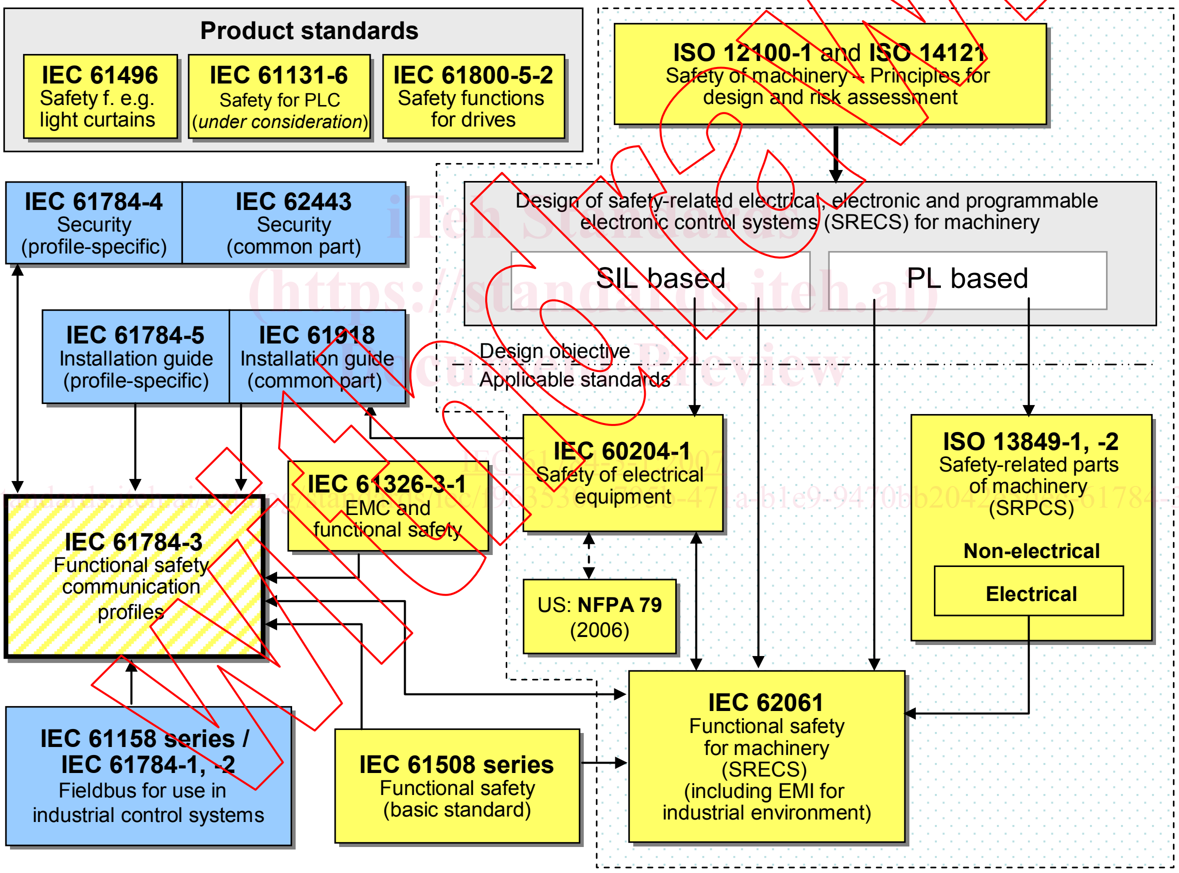
IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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 many fieldbus enhancements are emerging, addressing not yet standardized 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.


Product standards
IEC 61496 Safety f. e.g. light curtains
IEC 61131-6 Safety for PLC (under consideration)
IEC 61800-5-2 Safety functions for drives
ISO 12100-1 and ISO 14121 Safety of machinery – Principles for design and risk assessment
IEC 61784-4 Security (profile-specific)
IEC 62443 Security (common part)
Design of safety-related electrical, electronic and programmable electronic control systems (SRECS) for machinery
SIL based
PL based
IEC 61784-5 Installation guide (profile-specific)
IEC 61918 Installation guide (common part)
Design objective
Applicable standards
IEC 60204-1 Safety of electrical equipment
ISO 13849-1, -2 Safety-related parts of machinery (SRPCS)
Non-electrical
Electrical
IEC 61326-3-1 EMC and functional safety
IEC 61784-3 Functional safety communication profiles
US: NFPA 79 (2006)
IEC 62061 Functional safety for machinery (SRECS) (including EMI for industrial environment)
IEC 61158 series / IEC 61784-1, -2 Fieldbus for use in industrial control systems
IEC 61508 series Functional safety (basic standard)

Key

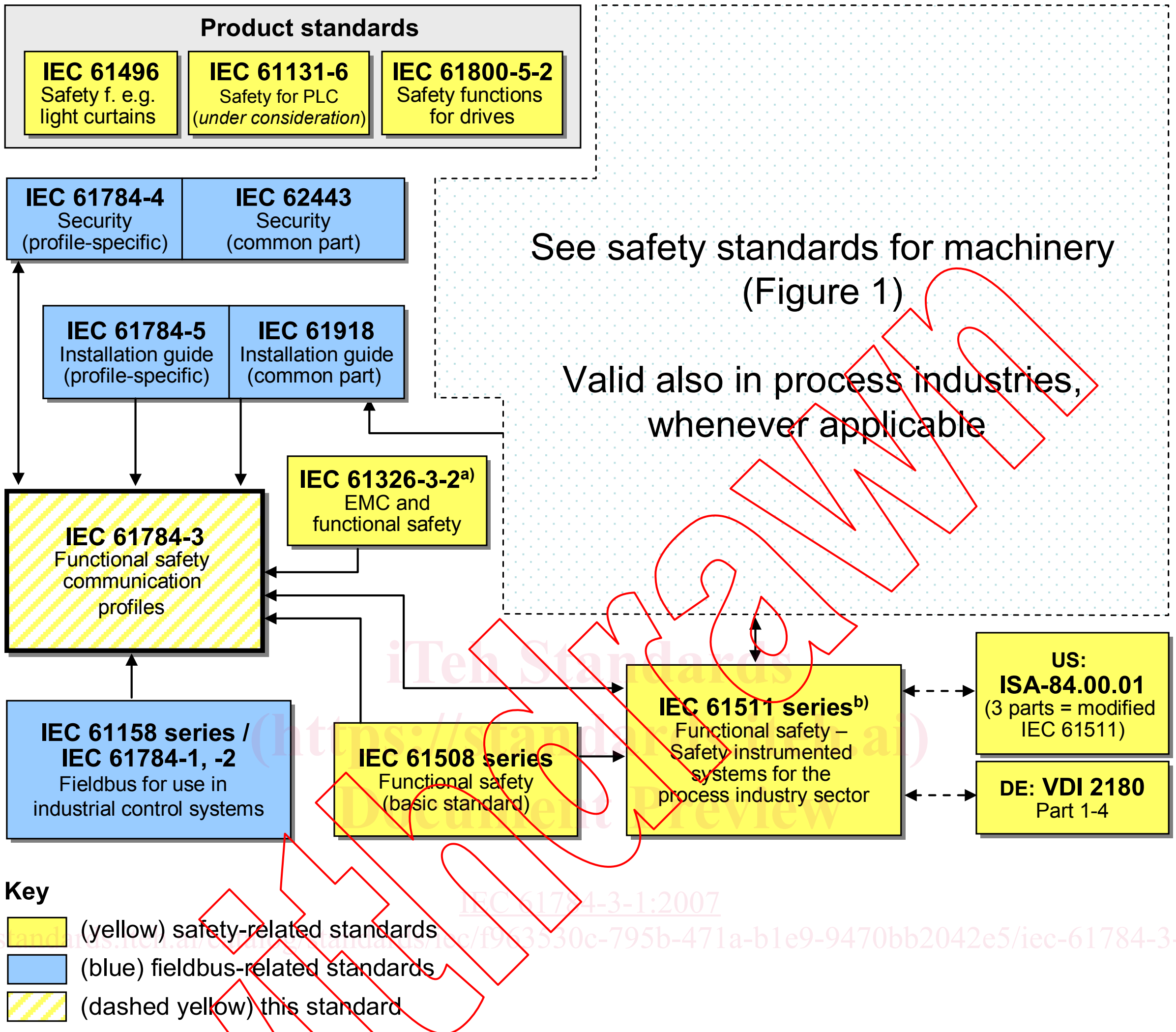
🟨 (yellow) safety-related standards

🟦 (blue) fieldbus-related standards

▨ (dashed yellow) this standard

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.


Product standards
IEC 61496
Safety f. e.g. light curtains
IEC 61131-6
Safety for PLC
(under consideration)
IEC 61800-5-2
Safety functions for drives
IEC 61784-4
Security
(profile-specific)
IEC 62443
Security
(common part)
See safety standards for machinery (Figure 1)
Valid also in process industries, whenever applicable
IEC 61784-5
Installation guide
(profile-specific)
IEC 61918
Installation guide
(common part)
IEC 61326-3-2a)
EMC and functional safety
IEC 61784-3
Functional safety communication profiles
IEC 61511 seriesb)
Functional safety – Safety instrumented systems for the process industry sector
US:
ISA-84.00.01
(3 parts = modified IEC 61511)
DE: VDI 2180
Part 1-4
IEC 61158 series /
IEC 61784-1, -2
Fieldbus for use in industrial control systems
IEC 61508 series
Functional safety
(basic standard)
Key
(yellow) safety-related standards
(blue) fieldbus-related standards
(dashed yellow) this standard

[a] For specified electromagnetic environments; otherwise IEC 61326-3-1.

[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 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;
- individual description of functional safety profiles for several communication profile families in IEC 61784-1 and IEC 61784-2;
- safety layer extensions to the communication service and protocols sections of the IEC 61158 series.

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES

Part 3-1: Functional safety fieldbuses – Additional specifications for CPF 1

1 Scope

This part of the IEC 61784-3 series specifies a safety communication layer (services and protocol) based on CPF 1 of IEC 61784-1 and IEC 61158 Type 1 and 9. It identifies the principles for functional safety communications defined in IEC 61784-3 that are relevant for this safety communication layer.

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 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 referenced documents are indispensable for the application 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, *Programmable controllers – Part 2: Equipment requirements and tests*

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

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

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

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

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

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

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

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

IEC 61508 (all parts), *Functional safety of 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 61784-3, *Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions*

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

IEC 62280-1:2002, *Railway applications – Communication, signalling and processing systems – Part 1: Safety-related communication in closed transmission systems*

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.

3.1.1 Common terms and definitions

3.1.1.1
availability
probability for an automated system that for a given period of time there are no unsatisfactory system conditions such as loss of production

NOTE Availability depends on MTBF (mean time between failure) and MDT (mean down time):
Availability = MTBF / (MTBF + MDT).

3.1.1.2
black channel
communication channel without available evidence of design or validation according to IEC 61508 series

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

3.1.1.4
communication channel
logical connection between two end-points within a *communication system*

3.1.1.5
communication system
arrangement of hardware, software and propagation media to allow the transfer of *messages* (ISO/IEC 7498 application layer) from one application to another

3.1.1.6
connection
logical binding between two application objects within the same or different devices