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INTERNATIONAL STANDARD

Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions

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FOREWORD

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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 functional safety communication profiles for families 1, 2, 3 and 6 given in IEC 61784-3-1, IEC 61784-3-2, IEC 61784-3-3 and IEC 61784-3-6.

IEC takes no position concerning the evidence, validity and scope of these patent rights.The holders of these patent 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 statements of the holders of these patent rights are registered with IEC.

NOTE Patent details and corresponding contact information are provided in IEC 61784-3-1, IEC 61784-3-2, IEC 61784-3-3 and IEC 61784-3-6.

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

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.

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- withdrawn,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 communications networks – Profiles – Functional safety fieldbuses*, can be found on the IEC website.

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.

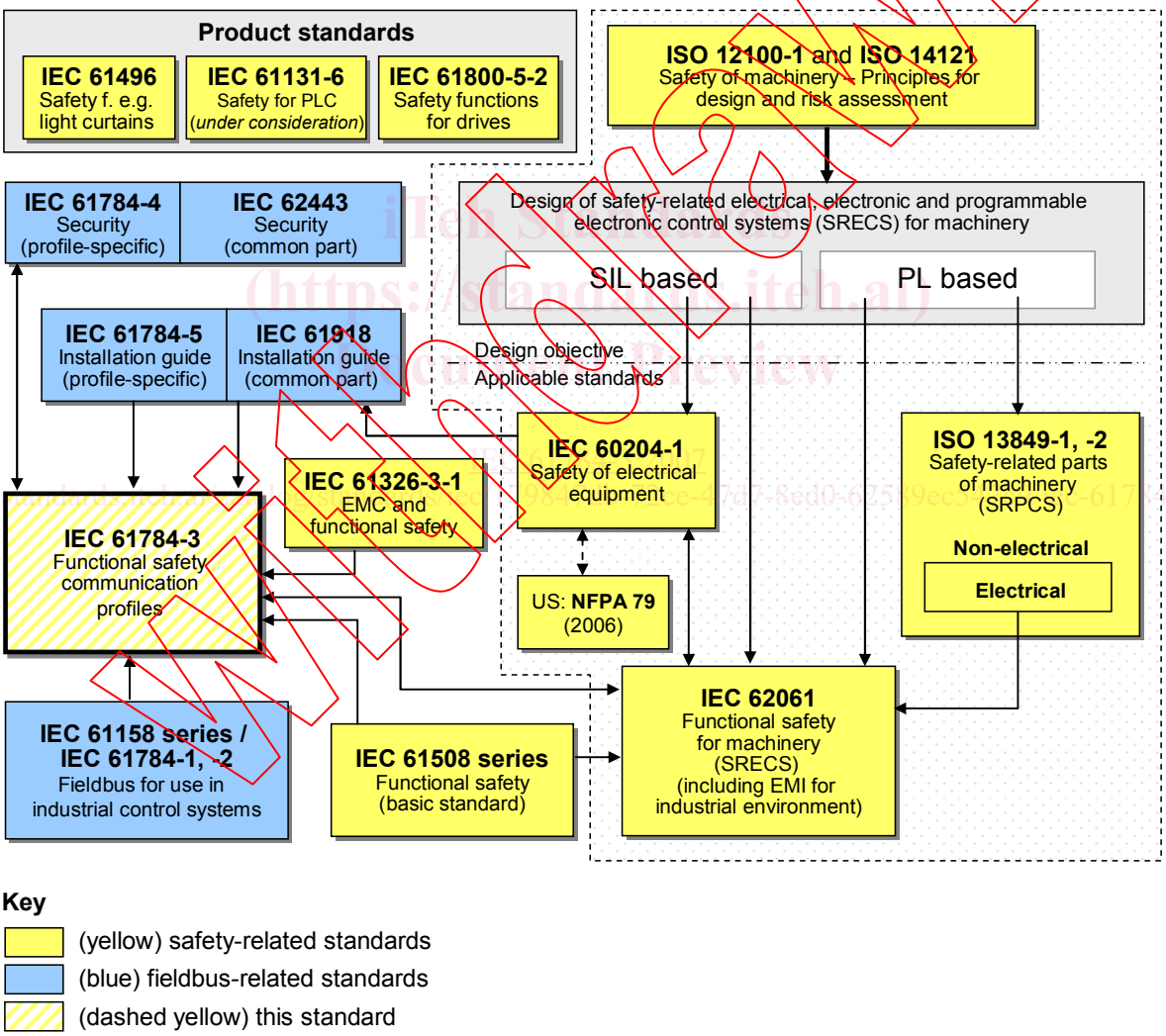
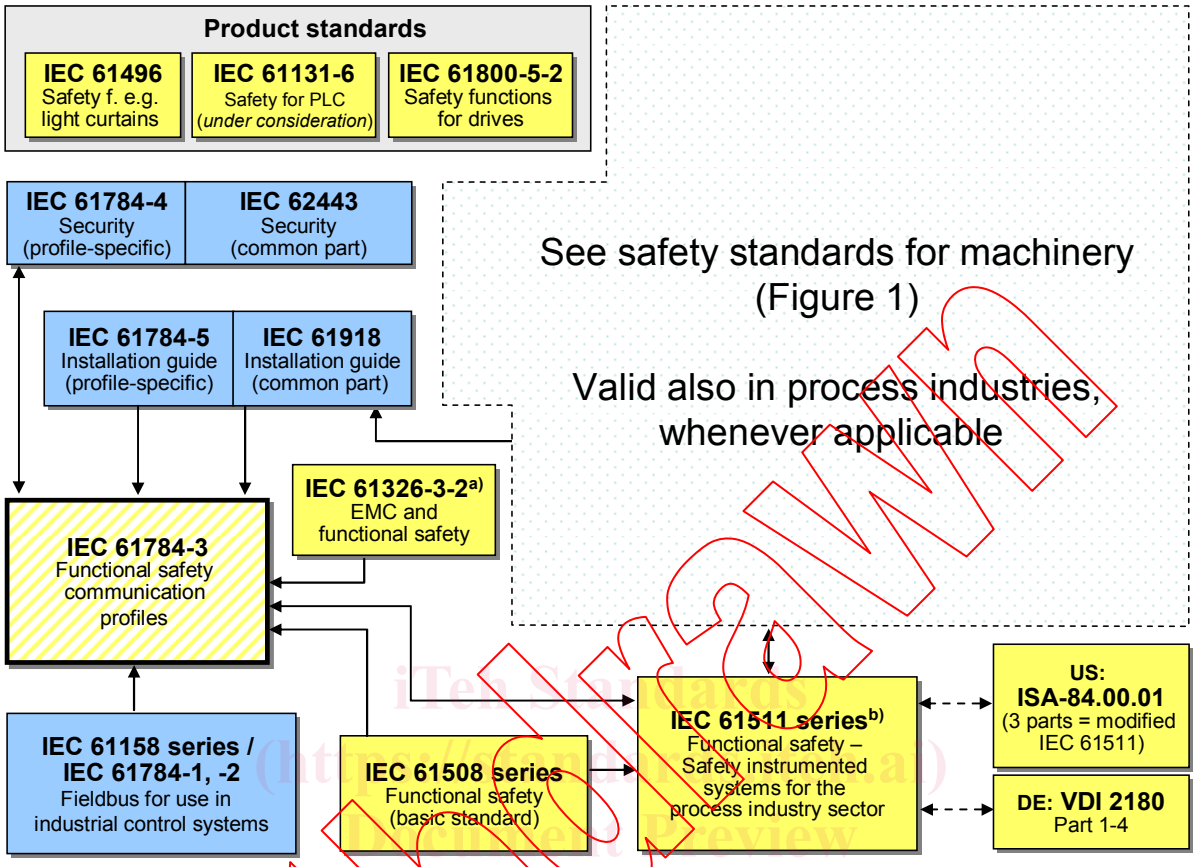


Figure 1 – Relationships of IEC 61784-3 with other standards (machinery)

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.

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 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: Functional safety fieldbuses – General rules and profile definitions

1 Scope

This part of the IEC 61784-3 series explains some common principles than can be used in 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 principles can be used in various industrial applications such as process control, manufacturing automation and machinery.

This part[1] and the IEC 61784-3-x parts specify several functional safety communication profiles based on the communication profiles and protocol layers of the fieldbus technologies in IEC 61784-1, IEC 61784-2 and the IEC 61158 series.

NOTE 1 Other safety-related communication systems meeting the requirements of IEC 61508 series may exist that are not included in this standard.

NOTE 2 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.

All systems are exposed to unauthorized access at some point of their life cycle. Additional measures need to be considered in any safety-related application to protect fieldbus systems against unauthorized access. IEC 62443 will address many of these issues; the relationship with IEC 62443 is detailed in a dedicated subclause of this part.

NOTE 3 Additional profile specific requirements for security may also be specified in the future IEC 61784-4.

NOTE 4 Implementation of a functional safety communication profile according to this part in a device is not sufficient to qualify it as a safety device, as defined in IEC 61508 series.

NOTE 5 The resulting SIL claim of a system depends on the implementation of the selected functional safety communication profile within this system.

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 (all parts), *Industrial communication networks – Fieldbus specifications*

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*[2]

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 EM environment*[2]

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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 To be published.

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

IEC 61508-1, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

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 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 61784-3-1, *Industrial communication networks – Profiles – Part 3-1: Functional safety fieldbuses – Additional specifications for CPF 1*

IEC 61784-3-2, *Industrial communication networks – Profiles – Part 3-2: Functional safety fieldbuses – Additional specifications for CPF 2*

IEC 61784-3-3, *Industrial communication networks – Profiles – Part 3-3: Functional safety fieldbuses – Additional specifications for CPF 3*

IEC 61784-3-6, *Industrial communication networks – Profiles – Part 3-6: Functional safety fieldbuses – Additional specifications for CPF 6*

IEC 61784-5 (all parts), *Industrial communication networks – Profiles – Part 5: Installation of fieldbuses – Installation profiles for CPF x*

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
absolute time stamp
time stamp referenced to a global time which is common for a group of devices using a *fieldbus*
[IEC 62280-2, modified]

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

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

3.1.1.3
black channel
communication channel without available evidence of design or validation according to IEC 61508 series

3.1.1.4
bridge
abstract device that connects multiple network segments along the data link layer

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 application layer) from one application to another

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

3.1.1.8
Cyclic Redundancy Check (CRC)
<value> redundant data derived from, and stored or transmitted together with, a block of data in order to detect data corruption

<method> procedure used to calculate the redundant data

NOTE 1 Terms “CRC code” and "CRC signature" , and labels such as CRC1, CRC2, may also be used in this standard to refer to the redundant data.

NOTE 2 See also [26], [27].[3]

3.1.1.9
diversity
different means of performing a required function

EXAMPLE Diversity may be achieved by different physical methods or different design approaches.

[IEC 61508-4:1998]

3.1.1.10
error
discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition

NOTE 1 An error can be caused by a faulty item, e.g. a computing error made by faulty computer equipment.

[IEV 191-05-24], [IEC 61508-4:1998], [IEC 61158]

NOTE 2 Errors may be due to design mistakes within hardware/software and/or corrupted information due to electromagnetic interference and/or other effects.

NOTE 3 Errors do not necessarily result in a *failure* or a *fault*.

3.1.1.11
failure
termination of the ability of a functional unit to perform a required function

[3] Figures in square brackets refer to the bibliography.