IEC 61784-3-18

Edition 1.0 2011-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – Profiles
Part 3-18: Functional safety fieldbuses – Additional specifications for CPF 18

Réseaux de communication industriels – Profils
Partie 3-18: Bus de terrain de sécurité fonctionnelle – Spécifications supplémentaires pour le CPF 18

IEC 61784-3-18:2011

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INDUSTRIAL COMMUNICATION NETWORKS – PROFILES

Part 3-18: Functional safety fieldbuses – Additional specifications for CPF 18

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 61784-3-18 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial process measurement, control and automation.

This standard cancels and replaces IEC/PAS 61784-3-18 published in 2009. This first edition constitutes a technical revision.

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

FDIS	Report on voting
65C/639/FDIS	65C/649/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.

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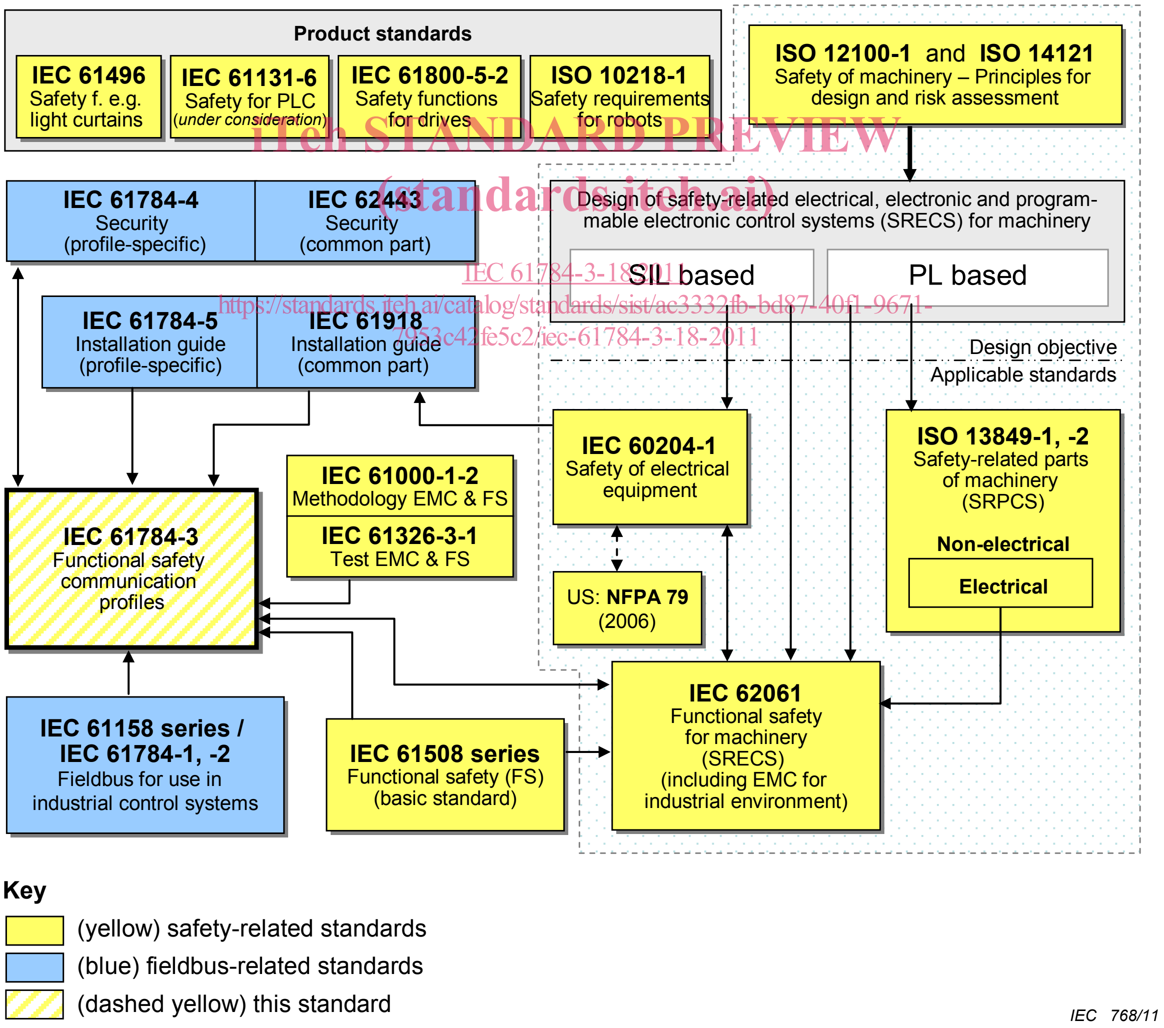
0 Introduction

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 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.

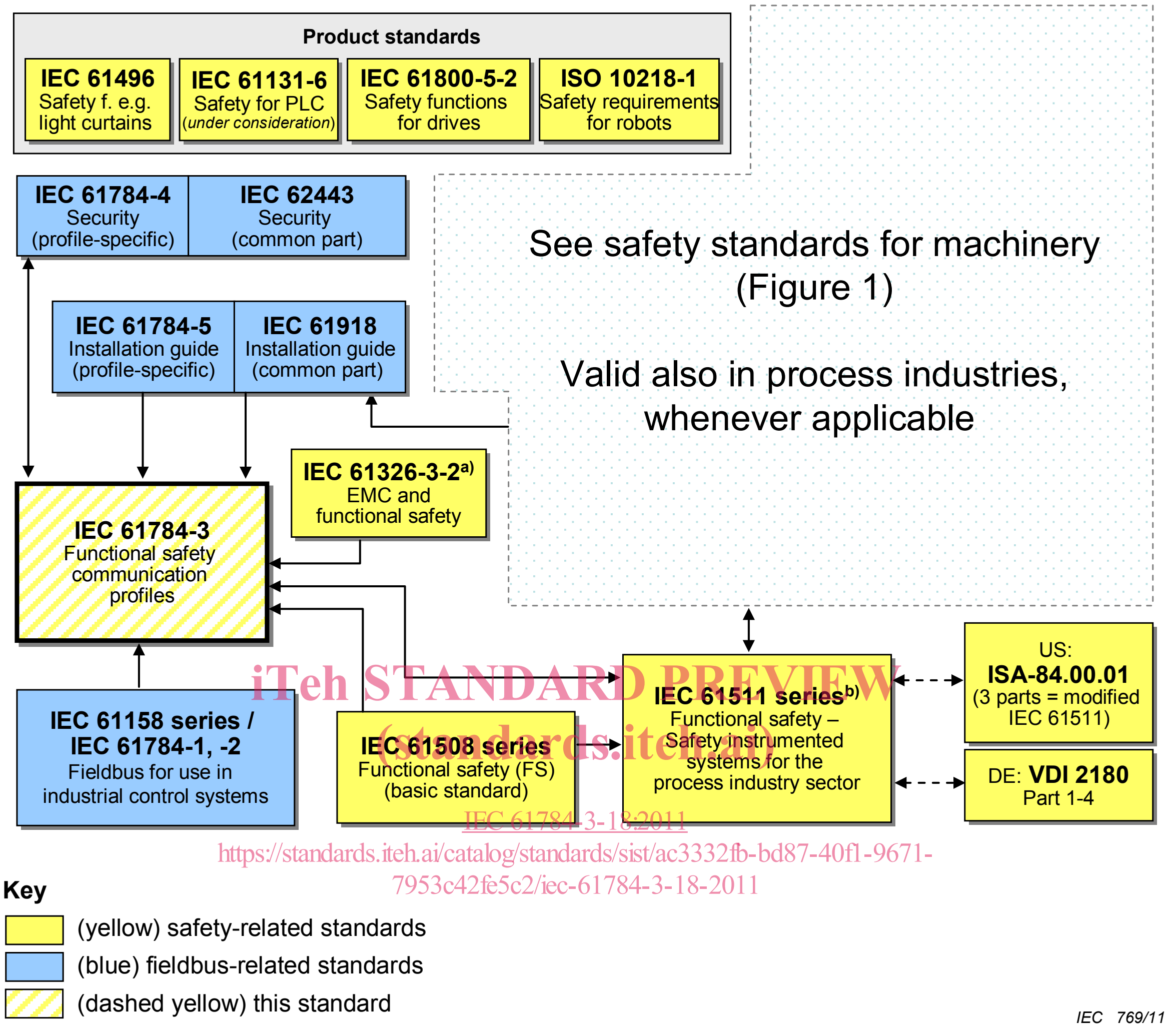
Figure 1 shows the relationships between this standard and relevant safety and fieldbus standards in a machinery environment.


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 10218-1
Safety requirements for robots
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 61000-1-2
Methodology EMC & FS
IEC 61326-3-1
Test EMC & FS
IEC 61784-3
Functional safety communication profiles
US: NFPA 79 (2006)
IEC 62061
Functional safety for machinery (SRECS) (including EMC for industrial environment)
IEC 61158 series / IEC 61784-1, -2
Fieldbus for use in industrial control systems
IEC 61508 series
Functional safety (FS) (basic standard)
Key
(yellow) safety-related standards
(blue) fieldbus-related standards
(dashed yellow) this standard
IEC 768/11

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.

[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.

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 a patent concerning the functional safety communication profiles for family 18 as follows, where the [xx] notation indicates the holder of the patent right:

DE 10 2008 007 672.4-31 [PI] Verfahren und Vorrichtung zum Übertragen von Daten in einem Netzwerk

IEC takes no position concerning the evidence, validity and scope of this patent right.

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Information may be obtained from:

[PI] Pilz GmbH & Co. KG
Felix-Wankel-Str. 2
73760 Ostfildern
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://www.iec.ch/tctools/patent_decl.htm) 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 3-18: Functional safety fieldbuses – Additional specifications for CPF 18

1 Scope

This part of the IEC 61784-3 series specifies a safety communication layer (services and protocol) based on CPF 18 of IEC 61784-2 and IEC 61158 Type 22. 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[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 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 61158-3-22, *Industrial communication networks – Fieldbus specifications – Part 3-22: Data-link layer service definition – Type 22 elements*

IEC 61158-4-22, *Industrial communication networks – Fieldbus specifications – Part 4-22: Data-link layer protocol specification – Type 22 elements*

IEC 61158-5-22, *Industrial communication networks – Fieldbus specifications – Part 5-22: Application layer service definition – Type 22 elements*

IEC 61158-6-22, *Industrial communication networks – Fieldbus specifications – Part 6-22: Application layer protocol specification – Type 22 elements*

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

[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 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61784-2:2010, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*

IEC 61784-3:2010, *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*

ISO/IEC 10731*, Information technology – Open system interconnection – Basic reference model – Conventions for the definition of OSI services*

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

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

3.1.1.3
communication channel
logical connection between two end-points within a *communication system*

3.1.1.4
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

3.1.1.5
connection
logical binding between two application objects within the same or different devices

3.1.1.6
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 [35], [36][3].

3.1.1.7
error

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

[IEC 61508-4:2010], [IEC 61158]

NOTE 1 Errors may be due to design mistakes within hardware/software and/or corrupted information due to electromagnetic interference and/or other effects.

NOTE 2 Errors do not necessarily result in a *failure* or a *fault*.

3.1.1.8
failure

termination of the ability of a functional unit to perform a required function or operation of a functional unit in any way other than as required

NOTE 1 The definition in IEC 61508-4 is the same, with additional notes.

[IEC 61508-4:2010, modified], [ISO/IEC 2382-14.01.11, modified]

NOTE 2 Failure may be due to an *error* (for example, problem with hardware/software design or message disruption).

3.1.1.9
fault

abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function

NOTE IEV 191-05-01 defines “fault” as a state characterized by the inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources.

[IEC 61508-4:2010, modified], [ISO/IEC 2382-14.01.10, modified]

3.1.1.10
fieldbus

communication system based on serial data transfer and used in industrial automation or process control applications

3.1.1.11
frame

denigrated synonym for DLPDU

3.1.1.12
Frame Check Sequence (FCS)

redundant data derived from a block of data within a DLPDU (frame), using a hash function, and stored or transmitted together with the block of data, in order to detect data corruption

NOTE 1 An FCS can be derived using for example a CRC or other hash function.

NOTE 2 See also [35], [36].

3.1.1.13
hash function

(mathematical) function that maps values from a (possibly very) large set of values into a (usually) smaller range of values

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

NOTE 1 Hash functions can be used to detect data corruption.

NOTE 2 Common hash functions include parity, checksum or CRC.

[IEC/TR 62210, modified]

3.1.1.14
hazard
state or set of conditions of a system that, together with other related conditions will inevitably lead to harm to persons, property or environment

3.1.1.15
message
ordered series of octets intended to convey information

[ISO/IEC 2382-16.02.01, modified]

3.1.1.16
message sink
part of a *communication system* in which *messages* are considered to be received

[ISO/IEC 2382-16.02.03]

3.1.1.17
message source
part of a *communication system* from which *messages* are considered to originate

[ISO/IEC 2382-16.02.02]

3.1.1.18
nuisance trip
spurious trip with no harmful effect

NOTE Internal abnormal errors can be caused in communication systems such as wireless transmission, for example by too many retries in the presence of interferences.

3.1.1.19
performance level (PL)
discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

[ISO 13849-1]

3.1.1.20
redundancy
existence of means, in addition to the means which would be sufficient for a functional unit to perform a required function or for data to represent information

[IEC 61508-4:2010, modified], [ISO/IEC 2382-14.01.12, modified]

3.1.1.21
risk
combination of the probability of occurrence of harm and the severity of that harm

NOTE For more discussion on this concept see Annex A of IEC 61508-5:2010.

[IEC 61508-4:2010], [ISO/IEC Guide 51:1999, definition 3.2]

3.1.1.22
safety communication layer (SCL)
communication layer that includes all the necessary measures to ensure safe transmission of data in accordance with the requirements of IEC 61508