



**NSAI**  
Standards

Irish Standard  
I.S. EN 61784-3-1:2010

# Industrial communication networks - Profiles -- Part 3-1: Functional safety fieldbuses - Additional specifications for CPF 1 (IEC 61784-3-1:2010 (EQV))

## I.S. EN 61784-3-1:2010

*Incorporating amendments/corrigenda issued since publication:*

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

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|--|--|---|
| <i>This document replaces:</i><br>EN 61784-3-1:2008  | <i>This document is based on:</i><br>EN 61784-3-1:2010<br>EN 61784-3-1:2008    | <i>Published:</i><br>13 August, 2010<br>13 June, 2008                     |
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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 61784-3-1**

August 2010

ICS 25.040.40;35.100.05

Supersedes EN 61784-3-1:2008

English version

**Industrial communication networks -  
Profiles -  
Part 3-1: Functional safety fieldbuses -  
Additional specifications for CPF 1  
(IEC 61784-3-1:2010)**

Réseaux de communication industriels -  
Partie 3-1: Bus de terrain à sécurité  
fonctionnelle -  
Spécifications complémentaires  
pour le CPF 1  
(CEI 61784-3-1:2010)

Industrielle Kommunikationsnetze -  
Profile -  
Teil 3-1: Funktional sichere Übertragung  
bei Feldbussen -  
Zusätzliche Festlegungen  
für die Kommunikationsprofilfamilie 1  
(IEC 61784-3-1:2010)

This European Standard was approved by CENELEC on 2010-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## **Foreword**

The text of document 65C/591A/FDIS, future edition 2 of IEC 61784-3-1, prepared by SC 65C, Industrial networks, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61784-3-1 on 2010-07-01.

This European Standard supersedes EN 61784-3-1:2008.

The main technical changes with respect to EN 61784-3-1:2008 are listed below:

- updates in relation with changes in EN 61784-3;
- adjustment of Figure 5;
- change of sequence number from two octets to four octets in 7.2.2 to match the final protocol from the consortium.
- addition of details for time synchronization in 7.2.4;
- addition of information for safety response time in 9.3;
- addition of information in constraints for calculation of system characteristics in 9.5.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- |  |       |            |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2011-04-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn   | (dow) | 2013-07-01 |

Annex ZA has been added by CENELEC.

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## **Endorsement notice**

The text of the International Standard IEC 61784-3-1:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

|                    |      |   |
|--------------------|------|---|
| IEC 60204-1        | NOTE | Harmonized as EN 60204-1.                           |
| IEC 61158 series   | NOTE | Harmonized in EN 61158 series (not modified).       |
| IEC 61326-3-1      | NOTE | Harmonized as EN 61326-3-1                          |
| IEC 61326-3-2      | NOTE | Harmonized as EN 61326-3-2.                         |
| IEC 61496 series   | NOTE | Harmonized in EN 61496 series (partially modified). |
| IEC 61508-5:2010   | NOTE | Harmonized as EN 61508-5:2010 (not modified).       |
| IEC 61508-6:2010   | NOTE | Harmonized as EN 61508-6:2010 (not modified).       |
| IEC 61784-2        | NOTE | Harmonized as EN 61784-2.                           |
| IEC 61784-5 series | NOTE | Harmonized in EN 61784-5 series (not modified).     |
| IEC 61800-5-2      | NOTE | Harmonized as EN 61800-5-2.                         |
| IEC 62061          | NOTE | Harmonized as EN 62061.                             |
| ISO 10218-1        | NOTE | Harmonized as EN ISO 10218-1.                       |
| ISO 12100-1        | NOTE | Harmonized as EN ISO 12100-1.                       |
| ISO 13849-1        | NOTE | Harmonized as EN ISO 13849-1.                       |
| ISO 13849-2        | NOTE | Harmonized as EN ISO 13849-2.                       |
| ISO 14121          | NOTE | Harmonized as EN ISO 14121.                         |

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## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

| <u>Publication</u> | <u>Year</u> | <u>Title</u>  | <u>EN/HD</u> | <u>Year</u> |
|--------------------|-------------|---|--------------|-------------|
| IEC 61131-2        | -           | Programmable controllers -<br>Part 2: Equipment requirements and tests  | EN 61131-2   | -           |
| IEC 61158-2        | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 2: Physical layer specification and service<br>definition          | EN 61158-2   | -           |
| IEC 61158-3-1      | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 3-1: Data-link layer service definition -<br>Type 1 elements       | EN 61158-3-1 | -           |
| IEC 61158-4-1      | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 4-1: Data-link layer protocol specification -<br>Type 1 elements   | EN 61158-4-1 | -           |
| IEC 61158-5-5      | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 5-5: Application layer service definition -<br>Type 5 elements     | EN 61158-5-5 | -           |
| IEC 61158-5-9      | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 5-9: Application layer service definition -<br>Type 9 elements     | EN 61158-5-9 | -           |
| IEC 61158-6-5      | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 6-5: Application layer protocol<br>specification - Type 5 elements | EN 61158-6-5 | -           |
| IEC 61158-6-9      | -           | Industrial communication networks - Fieldbus<br>specifications -<br>Part 6-9: Application layer protocol<br>specification - Type 9 elements | EN 61158-6-9 | -           |
| IEC 61508          | Series      | Functional safety of<br>electrical/electronic/programmable electronic<br>safety-related systems   | EN 61508     | Series      |
| IEC 61508-1        | 2010        | Functional safety of<br>electrical/electronic/programmable electronic<br>safety-related systems -<br>Part 1: General requirements           | EN 61508-1   | 2010        |

**I.S. EN 61784-3-1:2010**

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EN 61784-3-1:2010

| <u>Publication</u> | <u>Year</u> | <u>Title</u>   | <u>EN/HD</u> | <u>Year</u> |
|--------------------|-------------|--|--------------|-------------|
| 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  | EN 61508-2   | 2010        |
| IEC 61508-3        | 2010        | Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements  | EN 61508-3   | 2010        |
| IEC 61508-4        | 2010        | Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations  | EN 61508-4   | 2010        |
| IEC 61511          | Series      | Functional safety - Safety instrumented systems for the process industry sector  | EN 61511     | Series      |
| IEC 61784-1        | -           | Industrial communication networks - Profiles - Part 1: Fieldbus profiles   | EN 61784-1   | -           |
| IEC 61784-3        | 2010        | Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions  | EN 61784-3   | 2010        |
| IEC 61918          | -           | Industrial communication networks - Installation of communication networks in industrial premises  | EN 61918     | -           |
| IEC 62280-1        | -           | Railway applications - Communication, signalling and processing systems - Part 1: Safety-related communication in closed transmission systems  | -            | -           |
| ISO/IEC 8802-3     | -           | Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications | -            | -           |

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –**

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

### 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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- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

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 second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision. The main changes with respect to the previous edition are listed below:

- updates in relation with changes in IEC 61784-3;
- adjustment of Figure 5;
- change of sequence number from two octets to four octets in 7.2.2 to match the final protocol from the consortium.
- addition of details for time synchronization in 7.2.4;
- addition of information for safety response time in 9.3;
- addition of information in constraints for calculation of system characteristics in 9.5.

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

|               |                  |
|---------------|------------------|
| FDIS          | Report on voting |
| 65C/591A/FDIS | 65C/603/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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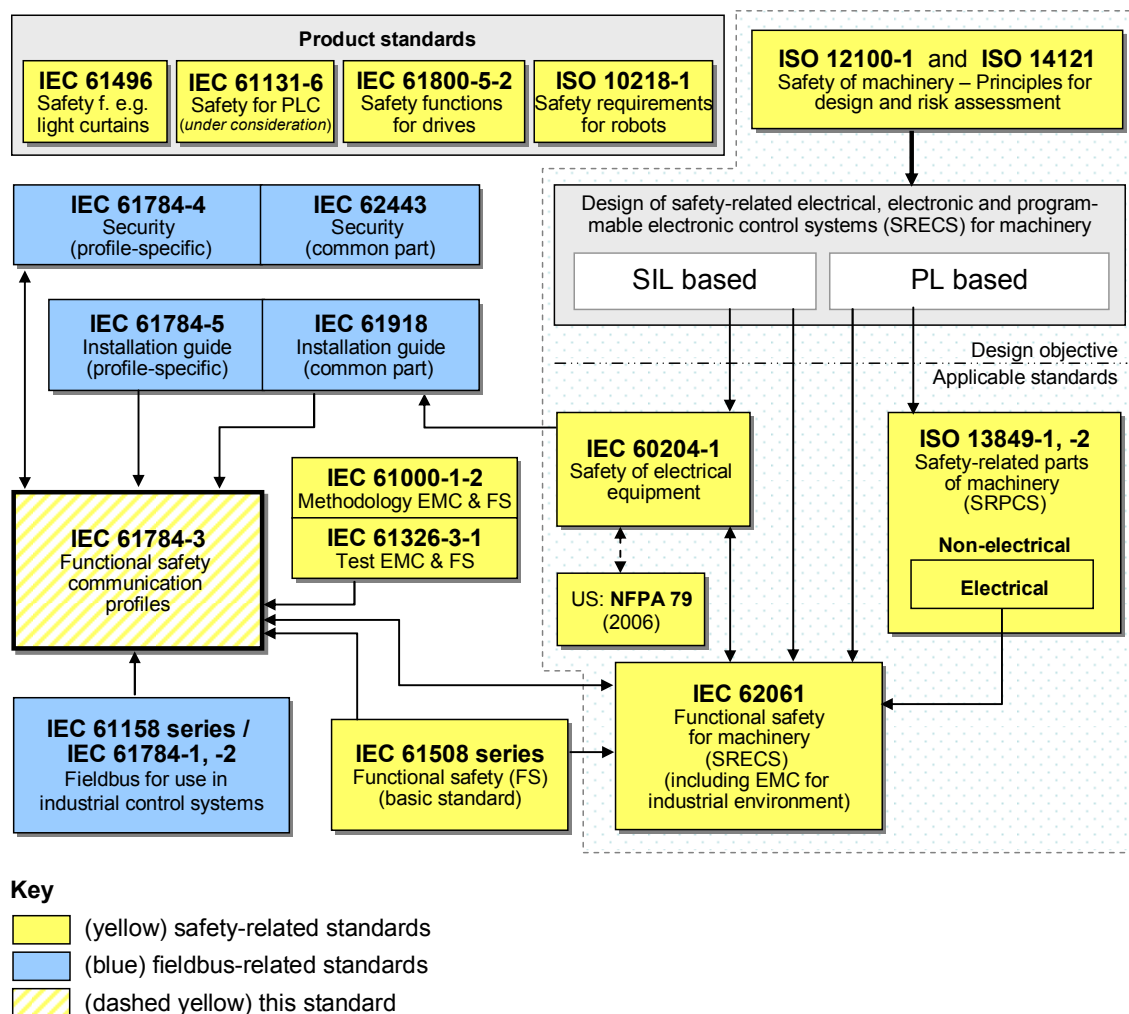
## 0 Introduction

### 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.

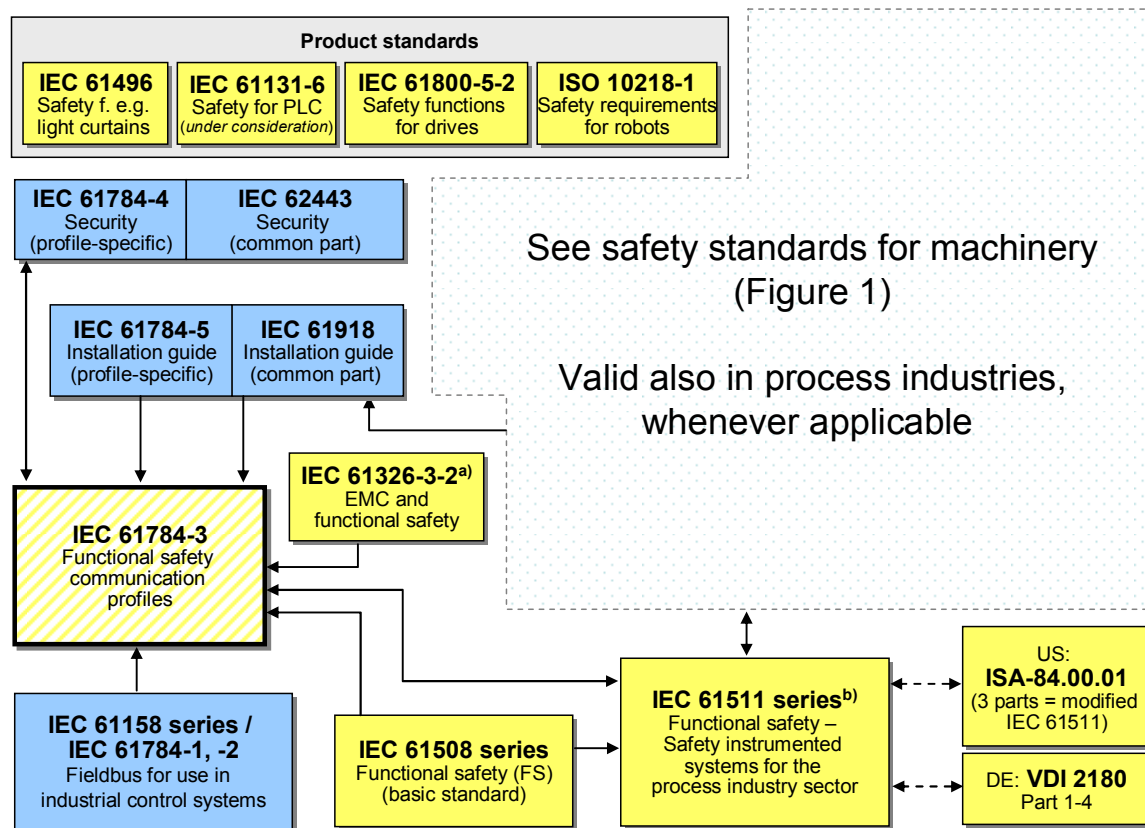


NOTE Subclauses 6.7.6.4 (high complexity) and 6.7.8.1.6 (low complexity) of IEC 62061 specify the relationship between PL (Category) and SIL.

**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.



#### Key

- (yellow) safety-related standards
- (blue) fieldbus-related standards
- (dashed yellow) this standard

<sup>a</sup> For specified electromagnetic environments; otherwise IEC 61326-3-1.

<sup>b</sup> 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 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     |
|      | USA                       |
|      | 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.

## 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 Types 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<sup>1</sup> 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<sup>2</sup> 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*

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

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

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