

BS EN 61158-2:2008

Incorporating corrigendum July 2011



BSI Standards Publication

ED 4 Industrial communication networks — Fieldbus specifications —

Part 2: Physical layer specification and service definition

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National foreword

This British Standard is the UK implementation of EN 61158-2:2008. It is identical to IEC 61158-2:2007. It supersedes BS EN 61158-2:2004, which is withdrawn. Together with BS EN 61158-3-16:2008, BS EN 61158-4-16:2008, BS EN 61158-5-16:2008 and BS EN 61158-6-16:2008, it partially supersedes BS EN 61491:1999, which will be withdrawn upon publication of a revised edition currently in progress and which will be implemented as a Technical Report.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications: process measurement and control, including fieldbus.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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ISBN 978 0 580 75802 7

ICS 25.040.40; 35.100.10; 35.240.50

Compliance with a British Standard cannot confer immunity from legal obligations.

This Draft for Development was published under the authority of the Standards Policy and Strategy Committee on 31 January 2009

Amendments/corrigenda issued since publication

Date	Text affected
31 July 2011	Modification of supersession details

**Industrial communication networks -
Fieldbus specifications -
Part 2: Physical layer specification and service definition
(IEC 61158-2:2007)**

Réseaux de communication industriels -
Spécifications des bus de terrain -
Partie 2: Spécification des couches
physiques et définition des services
(CEI 61158-2:2007)

Industrielle Kommunikationsnetze -
Feldbusse -
Teil 2: Spezifikation und
Dienstfestlegungen des Physical Layer
(Bitübertragungsschicht)
(IEC 61158-2:2007)

This European Standard was approved by CENELEC on 2008-02-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 65C/472/FDIS, future edition 4 of IEC 61158-2, 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 61158-2 on 2008-02-01.

This European Standard supersedes EN 61158-2:2004. Together with its companion parts for Type 16, it also partially replaces EN 61491:1998 which is at present being revised (to be issued as a Technical Report).

With respect to EN 61158-2:2004 the following changes were made:

- deletion of Type 6 fieldbus for lack of market relevance;
- addition of new fieldbus types;
- generalization of the seldom-used Type 1 radio to a more useful form.

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) 2008-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-02-01

NOTE Use of some of the associated protocol types is restricted by their intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a particular data-link layer protocol type to be used with physical layer and application layer protocols in type combinations as specified explicitly in the EN 61784 series. Use of the various protocol types in other combinations may require permission of their respective intellectual-property-right holders.

IEC and CENELEC draw attention to the fact that it is claimed that compliance with this standard may involve the use of patents as follows, where the [xx] notation indicates the holder of the patent right:

Type 2 (Subclauses 5.3, 9.3, 10.3, Clauses 17 through 20, Annex F through Annex H):

5,396,197 [AB] Network Node TAP

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

The holders of these patent rights have assured 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:

[AB]: Rockwell Technologies, LLC
Allen-Bradley Co, LLC
1201 So. Second Street
Milwaukee, WI 53204
USA
Attention: Intellectual Property Dept.

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

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61158-2:2007 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 60079-0	NOTE	Harmonized as EN 60079-0:2006 (modified).
IEC 60079-27	NOTE	Harmonized as EN 60079-27:2006 (not modified).
IEC 60227-5	NOTE	Harmonized as HD 21.5 S3:1994 (modified).
IEC 60875-1	NOTE	Harmonized as EN 60875-1:2001 (not modified).
IEC 60947-5-2	NOTE	Harmonized as EN 60947-5-2:2007 (not modified).
IEC 61300-3-4	NOTE	Harmonized as EN 61300-3-4:2001 (not modified).
IEC 61491	NOTE	Harmonized as EN 61491:1998 (modified).
IEC 61596	NOTE	Harmonized as EN 61596:1997 (not modified).
IEC 61784-1	NOTE	Harmonized as EN 61784-1:2008 (not modified).

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 60050-731	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 731: Optical fibre communication	-	-
IEC 60079-11	- ¹⁾	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"	EN 60079-11	2007 ²⁾
IEC 60079-14	- ¹⁾	Explosive atmospheres - Part 14: Electrical installations design, selection and erection	EN 60079-14	2003 ²⁾
IEC 60079-25	- ¹⁾	Electrical apparatus for explosive gas atmospheres - Part 25: Intrinsically safe systems	EN 60079-25 + corr. April	2004 ²⁾ 2006
IEC 60096-1	- ¹⁾	Radio-frequency cables - Part 1: General requirements and measuring methods	-	-
IEC 60169-8	- ^{1) 3)}	Radio-frequency connectors - Part 8: R.F. coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock - Characteristic impedance 50 ohms (Type BNC)	-	-
IEC 60169-17	- ¹⁾	Radio-frequency connectors - Part 17: R.F. coaxial connectors with inner diameter of outer conductor 6,5mm (0,256 in) with screw coupling - Characteristic impedance 50 ohms (type TNC)	-	-
IEC 60189-1	1986	Low-frequency cables and wires with PVC insulation and PVC sheath - Part 1: General test and measuring methods	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

³⁾ IEC 60169-8:1986 is superseded by IEC 61169-8:2007, which is harmonized as EN 61169-8:2007.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60255-22-1	1988	Electrical relays - Part 22-1: Electrical disturbance tests for measuring relays and protection equipment - 1 MHz burst disturbance tests	- ⁴⁾	-
IEC 60364-4-41 (mod)	- ¹⁾	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41 + corr. July	2007 ²⁾ 2007
IEC 60364-5-54 (mod)	- ¹⁾	Electrical installations of buildings - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors	HD 60364-5-54	2007 ²⁾
IEC 60529	- ¹⁾	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 ²⁾ 1993
IEC 60603-7	- ¹⁾	Connectors for frequencies below 3 MHz for use with printed boards - Part 7: Detail specification for connectors, 8-way, including fixed and free connectors with common mating features, with assessed quality	EN 60603-7	1997 ²⁾
IEC 60760	- ¹⁾	Flat, quick-connect terminations	-	-
IEC 60793 (mod)	Series	Optical fibres	EN 60793	Series
IEC 60794-1-2	- ¹⁾	Optical fibre cables - Part 1-2: Generic specification - Basic optical cable test procedures	EN 60794-1-2	2003 ²⁾
IEC 60807-3	- ¹⁾	Rectangular connectors for frequencies below 3 MHz - Part 3: Detail specification for a range of connectors with trapezoidal shaped metal shells and round contacts - Removable crimp types with closed crimp barrels, rear insertion/rear extraction	-	-
IEC 60874-10-1	- ¹⁾	Connectors for optical fibres and cables - Part 10-1: Detail specification for fibre optic connector type BFOC/2,5 terminated to multimode fibre type A1	-	-
IEC 61000-4-2	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995 ²⁾
IEC 61000-4-3	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006 ²⁾

⁴⁾ EN 60255-22-1:2008 is based on IEC 60255-22-1:2007.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-4	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2004 ²⁾
IEC 61131-2	- ¹⁾	Programmable controllers - Part 2: Equipment requirements and tests	EN 61131-2	2007 ²⁾
IEC 61156-1	- ¹⁾	Multicore and symmetrical pair/quad cables for digital communications - Part 1: Generic specification	-	-
IEC 61158-4-2	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 4-2: Data-link layer protocol specification - Type 2 elements	EN 61158-4-2	2008 ²⁾
IEC 61158-4-3	- ¹⁾	Industrial communication networks - Fieldbus specifications - Part 4-3: Data-link layer protocol specification - Type 3 elements	EN 61158-4-3	2008 ²⁾
IEC 61754-2	- ¹⁾	Fibre optic connector interfaces - Part 2: Type BFOC/2,5 connector family	EN 61754-2	1997 ²⁾
IEC 61754-13	- ¹⁾	Fibre optic connector interfaces - Part 13: Type FC-PC connector	EN 61754-13	2006 ²⁾
IEC 61754-22	- ¹⁾	Fibre optic connector interfaces - Part 22: Type F-SMA connector family	EN 61754-22	2005 ²⁾
ISO/IEC 7498	Series	Information technology - Open systems interconnection - Basic Reference Model: The Basic Model	EN ISO/IEC 7498	Series
ISO/IEC 8482	- ¹⁾	Information technology - Telecommunications - and information exchange between systems - Twisted pair multipoint interconnections	-	-
ISO/IEC 8802-3	- ¹⁾	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	-	-
ISO/IEC 9314-1	- ¹⁾	Information Processing Systems - Fibre distributed data interface (FDDI) - Part 1: Token Ring physical layer protocol (PHY)	EN 29314-1	1993 ²⁾
ISO/IEC 10731	- ¹⁾	Information technology - Open Systems Interconnection - Basic reference model - Conventions for the definition of OSI services	-	-
ANSI TIA/EIA-232-F	- ¹⁾	Interface between data terminal equipment and data circuit - Terminating equipment employing serial binary data interchange	-	-
ANSI TIA/EIA-422-B	- ¹⁾	Electrical characteristics of balanced voltage digital interface circuits	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ANSI TIA/EIA-485-A - ¹⁾		Electrical characteristics of generators and receivers for use in balanced digital multipoint systems	-	-
ANSI TIA/EIA-644-A - ¹⁾		Electrical Characteristics of Low Voltage Differential Signaling (LVDS) Interface Circuits	-	-

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0 Introduction

0.1 General

This part of IEC 61158 is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the “three-layer” fieldbus reference model described in IEC/TR 61158-1.

0.2 Physical layer overview

The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer Ph-entities at the time of communication.

The physical layer receives data units from the data-link Layer, encodes them, if necessary by adding communications framing information, and transmits the resulting physical signals to the transmission medium at one node. Signals are then received at one or more other node(s), decoded, if necessary by removing the communications framing information, before the data units are passed to the data-link Layer of the receiving device.

0.3 Document overview

This standard comprises physical layer specifications corresponding to many of the different DL-Layer protocol Types specified in IEC 61158-4-1 to IEC 61158-4-18.

NOTE 1 The protocol Type numbers used are consistent throughout the IEC 61158 series.

NOTE 2 Specifications for Types 1, 2, 3, 4, 8 and 16 are included. Type 7 uses Type 1 specifications. The other Types do not use any of the specifications given in this standard.

NOTE 3 For ease of reference, Type numbers are given in clause names. This means that the specification given therein applies to this Type, but does not exclude its use for other Types.

NOTE 4 It is up to the user of this standard to select interoperating sets of provisions. Refer to the IEC 61784 series for standardized communication profiles based on the IEC 61158 series.

A general model of the physical layer is shown in Figure 1.

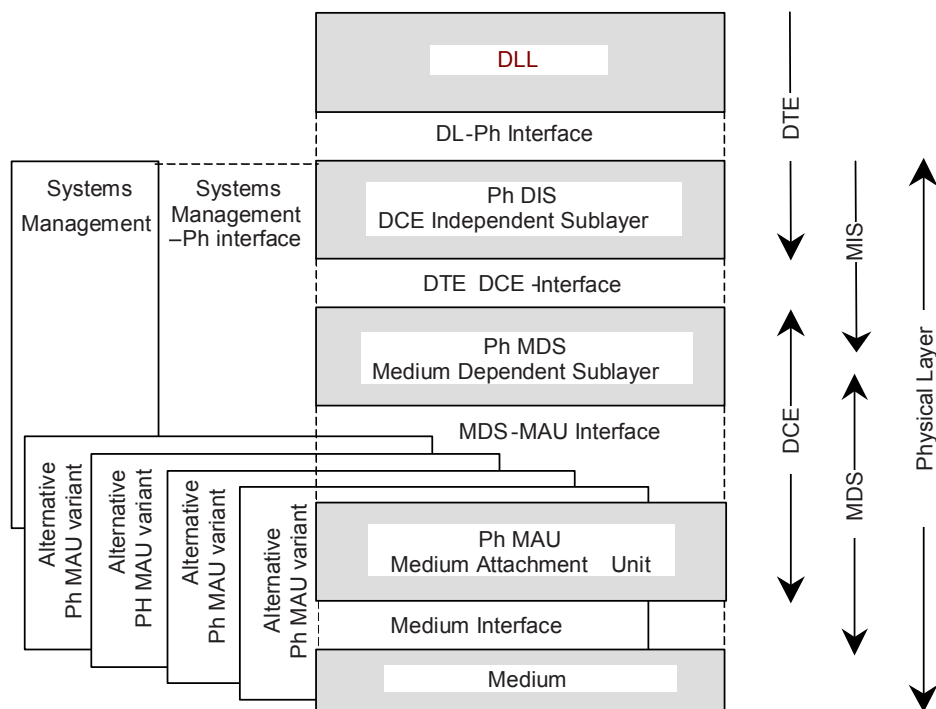


Figure 1 — General model of physical layer

NOTE 5 The protocol types use a subset of the structure elements.

NOTE 6 Since Type 8 uses a more complex DIS than the other types, it uses the term MIS to differentiate.

The common characteristics for all variants and types are as follows:

- digital data transmission;
- no separate clock transmission;
- either half-duplex communication (bi-directional but in only one direction at a time) or full-duplex communication.

0.4 Major physical layer variations specified in this standard

0.4.1 Type 1 media

0.4.1.1 Type 1: Wire media

For twisted-pair wire media, Type 1 specifies two modes of coupling and different signaling speeds as follows:

- a) voltage mode (parallel coupling), 150 Ω , data rates from 31,25 kbit/s to 25 Mbit/s;
- b) voltage mode (parallel coupling), 100 Ω , 31,25 kbit/s;
- c) current mode (serial coupling), 1,0 Mbit/s including two current options.

The voltage mode variations may be implemented with inductive coupling using transformers. This is not mandatory if the isolation requirements of this standard are met by other means.

The Type 1 twisted-pair (or untwisted-pair) wire medium physical layer provides the options:

- no power via the bus conductors; not intrinsically safe;
- power via the bus conductors; not intrinsically safe;
- no power via the bus conductors; intrinsically safe;
- power via the bus conductors; intrinsically safe.

0.4.1.2 Type 1: Optical media

The major variations of the Type 1 optic fiber media are as follows:

- dual fiber mode, data rates from 31,25 kbit/s to 25 Mbit/s;
- single fiber mode, 31,25 kbit/s.

0.4.1.3 Type 1: Radio media

The Type 1 radio medium specification provides a generalized FSK/PSK radio capability at arbitrary bit rates.

0.4.2 Type 2: Coaxial wire and optical media

Type 2 specifies the following variants:

- coaxial copper wire medium, 5 Mbit/s;
- optical fiber medium, 5 Mbit/s;
- network access port (NAP), a point-to-point temporary attachment mechanism that can be used for programming, configuration, diagnostics or other purposes;
- repeater machine sublayers (RM, RRM) and redundant physical layers.

0.4.3 Type 3: Twisted-pair wire and optical media

Type 3 specifies the following synchronous transmission:

- a) twisted-pair wire medium, 31,25 kbit/s, voltage mode (parallel coupling) with the options:
 - power via the bus conductors: not intrinsically safe;
 - power via the bus conductors: intrinsically safe;

and the following asynchronous transmission variants:

- b) twisted-pair wire medium, up to 12 Mbit/s, ANSI TIA/EIA-485-A;
- c) optical fiber medium, up to 12 Mbit/s.

0.4.4 Type 4: Wire medium

Type 4 specifies wire media with the following characteristics:

- RS-485 wire medium up to 76,8 kbit/s;
- RS-232 wire medium up to 230,4 kbit/s.

0.4.5 Type 8: Twisted-pair wire and optical media

The physical layer also allows transmitting data units that have been received through a medium access by the transmission medium directly through another medium access and its transmission protocol to another device.

Type 8 specifies the following variants:

- twisted-pair wire medium, up to 16 Mbit/s;
- optical fiber medium, up to 16 Mbit/s.

The general characteristics of these transmission media are as follows:

- full-duplex transmission;
- non-return-to-zero (NRZ) coding.

The wire media type provides the following options:

- no power supply via the bus cable, not intrinsically safe;
- power supply via the bus cable and on additional conductors, not intrinsically safe.

0.4.6 Type 12: Wire medium

Type 12 specifies wire media with the following characteristics:

- LVDS wire medium up 100 Mbit/s.

0.4.7 Type 16: optical media

Type 16 specifies a synchronous transmission using optical fiber medium, at 2 Mbit/s, 4 Mbit/s, 8 Mbit/s and 16 Mbit/s.

0.4.8 Type 18: Media

0.4.8.1 Type 18: Basic media

The Type 18-PhL-B specifies a balanced transmission signal over a shielded 3-core twisted cable. Communication data rates as high as 10 Mbit/s and transmission distances as great as 1,2 km are specified.

0.4.8.2 Type 18: Powered media

The Type 18-PhL-P specifies a balanced transmission signal over a 4-core unshielded cable in both flat and round configurations with conductors specified for communications signal and network-embedded power distribution. Communication data rates as high as 2,5 Mbit/s and transmission distances as great as 500 m are specified.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 2: Physical layer specification and service definition

1 Scope

This part of IEC 61158 specifies the requirements for fieldbus component parts. It also specifies the media and network configuration requirements necessary to ensure agreed levels of

- a) data integrity before data-link Layer error checking;
- b) interoperability between devices at the physical layer.

The fieldbus physical layer conforms to layer 1 of the OSI 7-layer model as defined by ISO 7498 with the exception that, for some types, frame delimiters are in the physical layer while for other types they are in the data-link Layer.

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 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication*

IEC 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”*

IEC 60079-14, *Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)*

IEC 60079-25, *Electrical apparatus for explosive gas atmospheres – Part 25: Intrinsically safe systems*

IEC 60096-1, *Radio-frequency cables – Part 1: General requirements and measuring methods*

IEC 60169-8, *Radio-frequency connectors – Part 8: RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock – Characteristic impedance 50 ohms (Type BNC)*

IEC 60169-17, *Radio-frequency connectors – Part 17: RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with screw coupling – Characteristic impedance 50 ohms (Type TNC)*

IEC 60189-1:1986, *Low-frequency cables and wires with PVC insulation and PVC sheath – Part 1: General test and measuring methods*¹

IEC 60255-22-1:1988, *Electrical relays – Part 22-1: Electrical disturbance tests for measuring relays and protection equipment – 1 MHz burst disturbance tests*²

¹ There exists a new edition of this publication (2007).

² There exists a new edition of this publication (2007).

IEC 60364-4-41, *Low-voltage electrical installations of buildings – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-5-54, *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60603-7, *Connectors for frequencies below 3 MHz for use with printed boards – Part 7: Detail specification for connectors, 8-way, including fixed and free connectors with common mating features, with assessed quality*

IEC 60760, *Flat, quick-connect terminations*

IEC 60793 (all parts), *Optical fibres*

IEC 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

IEC 60807-3, *Rectangular connectors for frequencies below 3 MHz – Part 3: Detail specification for a range of connectors with trapezoidal shaped metal shells and round contacts – Removable crimp contact types with closed crimp barrels, rear insertion/rear extraction*

IEC 60874-10-1, *Connectors for optical fibres and cables — Part 10-1: Detail specification for fiber optic connector type BFOC/2,5 terminated to multimode fibre type A1*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test* (Basic EMC Publication)

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test* (Basic EMC Publication)

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test* (Basic EMC Publication)

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

IEC 61156-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC 61158-4-2, *Industrial communication network – Fieldbus specifications — Part 4-2: Data-link protocol specification — Type 2 elements*

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

IEC 61754-2, *Fibre optic connector interfaces – Part 2: Type BFOC/2,5 connector family*

IEC 61754-13, *Fibre optic connector interfaces – Part 13: Type FC-PC connector*

IEC 61754-22, *Fibre optic connector interfaces – Part 22: Type F-SMA connector family*

ISO/IEC 7498 (all parts), *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 8482, *Information technology – Telecommunications and information exchange between systems – Twisted pair multipoint interconnections*

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*

ISO/IEC 9314-1, *Information processing systems – Fibre distributed data interface (FDDI) Part 1: Token ring physical layer protocol (PHY)*

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

ANSI TIA/EIA-232-F, *Interface Between Data Terminal Equipment and Data Circuit – Terminating Equipment Employing Serial Binary Data Interchange*

ANSI TIA/EIA-422-B, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*

ANSI TIA/EIA-485-A, *Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*

ANSI TIA/EIA-644-A, *Electrical Characteristics of Low Voltage Differential Signaling (LVDS) Interface Circuits*

3 Terms and definitions

For the purposes of this document, the terms and definitions of ISO/IEC 7498, and the following definitions apply.

3.1 Common terms and definitions

NOTE Many definitions are common to more than one protocol type; they are not necessarily used by all protocol types.

3.1.1 activity

presence of a signal or noise at the input terminals of a fieldbus device that is of a level that is above the receiver signal level threshold of that device

3.1.2 barrier

physical entity that limits current and voltage into a hazardous area in order to satisfy intrinsic safety requirements

3.1.3 bit

unit of data consisting of a 1 or a 0

NOTE A bit is the smallest data unit that can be transmitted.

3.1.4 bus

trunk and all devices connected to it

3.1.5 cable plant interface connector CPIC

point at which test and conformance measurements are made and that the interface between the network device and the cable plant

3.1.6 communication element

part of a fieldbus device that communicates with other elements via the bus

3.1.7 connector

coupling device employed to connect the medium of one circuit or communication element with that of another circuit or communication element
[IEEE Std 100-1996, modified]

3.1.8 coupler

physical interface between trunk and spur or trunk and device

3.1.9 Data Communications Equipment DCE

embodiment of the media, modulation and coding-dependent portion of a fieldbus-connected device, comprising the lower portions of the physical layer within the device

3.1.10**Data Terminal Equipment****DTE**

embodiment of the media, modulation and coding-independent portion of a fieldbus-connected device, comprising the uppermost portion of the physical layer and all higher layers within the device

3.1.11**decibel(milliwatt)****dB(mW)**

logarithmic unit of power, referenced to 1 mW. (Also written **dBm**.)

$$P_{\text{dBm}} = 10 \log (P_{\text{mW}})$$

NOTE If P_{mW} is the measured power in mW, then P_{dBm} is the power expressed logarithmically in dB(mW), or equivalently, dBm.

3.1.12**delimiter**

flag that separates and organizes items of data

3.1.13**device**

physical entity connected to the fieldbus composed of at least one communication element (the network element) and which may have a control element and/or a final element (transducer, actuator, etc.)

NOTE A device may contain more than one node.

3.1.14**effective launch power**

effective power coupled into the core of a fiber optic waveguide by the transmitter. This power is measured with a standard test fiber connected to the CPIC

3.1.15**effective power**

the difference, expressed in dBm, between the absolute optical power measured in milliwatt at the midpoint in time of the Hi level to the absolute optical power measured in milliwatt at the midpoint of the Lo level

NOTE Effective power is believed to give a more accurate measurement of the conditions that affect the receivers than traditional measurements, such as peak and average power. methods for measuring effective power are for further study.

3.1.16**error**

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

3.1.17**extinction ratio**

ratio of the absolute optical power measured in milliwatt at the midpoint in time of the Hi level to the absolute optical power measured in milliwatt at the midpoint in time of the Lo level.

NOTE The following gives an example of the computation of effective power and extinction ratio. If the midpoint of Hi level is measured as 105 μW , and if the midpoint of Lo level is measured as 5 μW , then the difference is 100 μW . Therefore, the effective power is $10 \log ((100 \mu\text{W}) / 1 \text{ mW})$, which equals $-10,0 \text{ dBm}$. The extinction ratio is $(105/5)$, which equals 21:1.

3.1.18**fiber optic cable**

cable containing one or more fiber optic waveguides with jacketing material provided to facilitate handling and to protect the fiber

3.1.19

fiber optic receiver

combined optics and electronics in the communicating device that accept the optical signal received by the communicating device through the CPIC

3.1.20

fiber optic receiver operating range

range of optical power that must be present at the CPIC to ensure that the bit error rate specifications are met

3.1.21

fiber optic transmitter

device that emits optical signals for propagation into a fiber optic waveguide through the CPIC

3.1.22

fiber optic waveguide

flexible, optically transparent strand that is used to transport optical signals from one geographic point to another geographic point

3.1.23

frame

set of consecutive digit time slots in which the position of each digit time slot can be identified by reference to a framing signal
[IEEE Std 100-1996]

3.1.24

intrinsic safety

design methodology for a circuit or an assembly of circuits in which any spark or thermal effect produced under normal operating and specified fault conditions is not capable under prescribed test conditions of causing ignition of a given explosive atmosphere
[IEC 60079-11]

3.1.25

isolation

physical and electrical arrangement of the parts of a signal transmission system to prevent electrical interference currents within or between the parts
[IEEE Std 100-1996]

3.1.26

jabber

continuous transmission on the medium due to a faulty device

3.1.27

jitter

offset of the 50 % transition points of pulse edges from their ideal position as the result of all causes

3.1.28

Manchester encoding

means by which separate data and clock signals can be combined into a single, self-synchronizing data stream, suitable for transmission on a serial channel

3.1.29

medium

cable, optical fiber, or other means by which communication signals are transmitted between two or more points

NOTE In this standard "media" is used only as the plural of medium.

3.1.30

network

all of the media, connectors, repeaters, routers, gateways and associated node communication elements by which a given set of communicating devices are interconnected

3.1.31

node

end-point of a branch in a network or a point at which one or more branches meet
[IEV 131-02-04]

3.1.32

optical active star

active device in which a signal from an input fiber is received, amplified and retransmitted to a larger number of output optical fibers. Retiming of the received signal is optional.

3.1.33

optical fall time

time it takes for a pulse to go from 90 % effective power to 10 % effective power, specified as a per cent of the nominal bit time

3.1.34

optical passive star

passive device in which signals from input fibers are combined and then distributed among output optical fibers

3.1.35

optical rise time

time it takes for a pulse to go from 10 % effective power to 90 % effective power, specified as a per cent of the nominal bit time

3.1.36

peak emission wavelength

λ_p

wavelength at which radiant intensity is maximized

3.1.37

receiver

receive circuitry of a communication element

3.1.38

repeater

Two-port active physical layer device that receives and retransmits all signals to increase the distance and number of devices for which signals can be correctly transferred for a given medium

3.1.39

segment

trunk-cable section of a fieldbus that is terminated in its characteristic impedance

NOTE Segments are linked by repeaters within a logical link and by bridges to form a fieldbus network

3.1.40

separately powered device

device that does not receive its operating power via the fieldbus signal conductors

3.1.41

shield

surrounding earthed metallic layer to confine the electric field within the cable and to protect the cable from external electrical influence

NOTE Metallic sheaths, armours and earthed concentric conductors may also serve as a shield.

3.1.42

spur

branch-line (i.e. a link connected to a larger one at a point on its route) that is a final circuit

NOTE The alternative term 'drop cable' is used in this standard.

3.1.43

terminator

resistor connecting conductor pairs at both ends of a wire medium segment to prevent reflections from occurring at the ends of cables

NOTE For Type 2 the terminator is mounted in a BNC or TNC plug.

3.1.44

transceiver

combination of receiving and transmitting equipment in a common housing employing common circuit components for both transmitting and receiving
[IEEE Std 100-1996 modified for non-radio use]

NOTE A medium attachment unit can be the transceiver or can contain the transceiver, depending on Type and implementation.

3.1.45

transmitter

transmit circuitry of a communication element

3.1.46

trunk

main communication highway acting as a source of main supply to a number of other lines (spurs)

3.1.47

typical half-intensity wavelength

$\Delta\lambda$

range of wavelength of spectral distribution in which the radiant intensity is no less than one-half of the maximum intensity

3.2 Type 1: Terms and definitions

3.2.1

activity

[see 3.1.1]

3.2.2

barrier

[see 3.1.2]

3.2.3

bus

[see 3.1.4]

3.2.4

cable plant interface connector

CPIC

[see 3.1.5]

3.2.5

communication element

[see 3.1.6]

3.2.6

connector

[see 3.1.7]

3.2.7

coupler

[see 3.1.8]

3.2.8

Data Communications Equipment

DCE

[see 3.1.9]

3.2.9

Data Terminal Equipment

DTE

[see 3.1.10]

3.2.10

dBm

[see 3.1.11]

3.2.11

delimiter

[see 3.1.12]

3.2.12

device

[see 3.1.13]

3.2.13

effective launch power

[see 3.1.14]

3.2.14

effective power

[see 3.1.15]

3.2.15

fiber optic cable

[see 3.1.17]

3.2.16

fiber optic receiver

[see 3.1.19]

3.2.17

fiber optic receiver operating range

[see 3.1.20]

3.2.18

fiber optic transmitter

[see 3.1.21]

3.2.19

fiber optic waveguide

[see 3.1.22]

3.2.20

frame

[see 3.1.23]

3.2.21

Gaussian minimum shift keying

form of frequency modulation where a 1 is represented by a frequency of $F_c + f$ and a 0 is represented by $F_c - f$ where f is equal to the bit rate divided by 4 and where the modulating frequency is first passed through a Gaussian filter before being imposed on the carrier

3.2.22

intrinsic safety

[see 3.1.24]

3.2.23

isolation

[see 3.1.25]

3.2.24

jabber

[see 3.1.26]

3.2.25

Manchester encoding

[see 3.1.27]

3.2.26

medium

[see 3.1.29]

3.2.27

network

[see 3.1.30]

3.2.28

node

[see 3.1.31]

3.2.29

optical fall time

[see 3.1.32]

3.2.30

optical rise time

[see 3.1.34]

3.2.31

peak emission wavelength

λ_p

[see 3.1.36]

3.2.32

repeater

[see 3.1.38]

3.2.33

segment

[see 3.1.39]

3.2.34
separately powered device
[see 3.1.40]

3.2.35
shield
[see 3.1.41]

3.2.36
spur
[see 3.1.42]

3.2.37
terminator
[see 3.1.43]

3.2.38
transceiver
[see 3.1.43]

3.2.39
transmitter
[see 3.1.45]

3.2.40
trunk
[see 3.1.46]

3.3 Type 2: Terms and definitions

3.3.1
activity
[see 3.1.1]

3.3.2
bit
[see 3.1.3]

3.3.3
blanking or blanking time
length of time required after transmitting before a node is allowed to receive

3.3.4
bus
[see 3.1.4]

3.3.5
communication element
[see 3.1.6]

3.3.6
connector
[see 3.1.7]

3.3.7
Data Communications Equipment (DCE)
[see 3.1.9]

3.3.8

dBm

[see 3.1.11]

3.3.9

delimiter

[see 3.1.12]

3.3.10

device

[see 3.1.13]

3.3.11

end delimiter

unique sequence of symbols that identifies the end of a frame

3.3.12

end node

producing or consuming node

3.3.13

error

[see 3.1.16]

3.3.14

frame

[see 3.1.23]

3.3.15

isolation

[see 3.1.25]

3.3.16

jabber

[see 3.1.26]

3.3.17

Manchester encoding

[see 3.1.27]

3.3.18

medium

[see 3.1.29]

3.3.19

M_symbol

representation of the MAC data bits to be encoded and transmitted by the physical layer

3.3.20

MAC frame

collection of M_symbols transmitted on the medium that contains a preamble, start delimiter, data, CRC and end delimiter

3.3.21

network

[see 3.1.30]

3.3.22

network access port

physical layer variant that allows a temporary node to be connected to the link by connection to the NAP of a permanent node

3.3.23

node

[see 3.1.31]

NOTE A node is additionally a connection to a link that requires a single M_ID

3.3.24

non-data symbol

physical layer Manchester coded signal, used for delimiters, carrying no data

3.3.25

optical isolators, optos

components located within the physical layer transceiver of a node that converts current into light, and then back to an electrical signal

3.3.26

permanent node

node whose connection to the network does not utilize the network access port (NAP)
physical layer variant

NOTE This node may optionally support a NAP physical layer variant to allow temporary nodes to connect to the network.

3.3.27

redundant media

more than one medium to minimize communication failures

3.3.28

repeater

[see 3.1.38]

3.3.29

segment

[see 3.1.39]

3.3.30

shield

[see 3.1.41]

3.3.31

slot time

maximum time required for detecting an expected transmission

NOTE Each node waits a slot time for each missing node during the implied token pass.

3.3.32

spur

[see 3.1.42]

NOTE This is an integral part of network taps.

3.3.33

start delimiter

unique sequence of symbols that identifies the beginning of a frame

3.3.34

tap

point of attachment from a node or spur to the trunk cable

NOTE A tap provides easy removal of a node without disrupting the link.

3.3.35

terminator

[see 3.1.43]

3.3.36

tool

executable software program that interacts with the user to perform some function

3.3.37

transceiver

[see 3.1.43]

3.3.38

transient node

node that is only intended to be connected to the network on a temporary basis using the NAP physical layer medium connected to the NAP of a permanent node

3.3.39

transmitter

[see 3.1.45]

3.3.40

trunk

[see 3.1.46]

3.3.41

trunk cable

bus or central part of a cable system

3.3.42

trunk–cable section

length of trunk cable between any two taps

3.4 Type 3: Terms and definitions

3.4.1

activity

[see 3.1.1]

3.4.2

barrier

[see 3.1.2]

3.4.3

bit time

time to transmit one bit

3.4.4

bus

[see 3.1.4]

3.4.5
communication element
[see 3.1.6]

3.4.6
confirmation (primitive)
[ISO/IEC 10731]

3.4.7
connector
[see 3.1.7]

3.4.8
coupler
[see 3.1.8]

3.4.9
Data Communications Equipment (DCE)
[see 3.1.9]

3.4.10
Data Terminal Equipment (DTE)
[see 3.1.10]

3.4.11
dBm
[see 3.1.11]

3.4.12
device
[see 3.1.13]

3.4.13
DL-entity
[ISO/IEC 7498-1]

3.4.14
fiber optic cable (FOC)
[see 3.1.17]

3.4.15
frame
[see 3.1.23]

3.4.16
indication (primitive)
[ISO/IEC 10731]

3.4.17
intrinsic safety
[see 3.1.24]

3.4.18
isolation
[see 3.1.25]

3.4.19

jabber

[see 3.1.26]

3.4.20

medium

[see 3.1.29]

3.4.21

(N)-entity

[ISO/IEC 7498-1]

3.4.22

(N)-service

[ISO/IEC 7498-1]

3.4.23

network

[see 3.1.30]

3.4.24

node

[see 3.1.31]

3.4.25

Ph-entity

[ISO/IEC 7498-1]

3.4.26

Ph-service

[ISO/IEC 7498-1]

3.4.27

repeater

[see 3.1.38]

3.4.28

request (primitive)

[ISO/IEC 10731]

3.4.29

reset

[ISO/IEC 7498-1]

3.4.30

segment

[see 3.1.39]

3.4.31

separately powered device

[see 3.1.40]

3.4.32

shield

[see 3.1.41]

3.4.33

spur

[see 3.1.42]

3.4.34

station

node

3.4.35

terminator

[see 3.1.43]

3.4.36

transceiver

[see 3.1.43]

3.4.37

transmitter

[see 3.1.45]

3.4.38

trunk

[see 3.1.46]

3.5 Type 4: Terms and definitions

3.5.1

activity

[see 3.1.1]

3.5.2

bus

[see 3.1.4]

3.5.3

connector

[see 3.1.7]

3.5.4

Data Communications Equipment (DCE)

[see 3.1.9]

3.5.5

Data Terminal Equipment (DTE)

[see 3.1.10]

3.5.6

device

[see 3.1.13]

3.5.7

idle counter

counter to measure the number of bit periods for which the signal level on the physical link has been high for normal class and simple class devices in half duplex mode

3.5.8

isolation

[see 3.1.25]

3.5.9

medium

[see 3.1.29]

3.5.10

network

[see 3.1.30]

3.5.11

normal class device

a device that initiates transmission and replies to requests and that can act as a server (responder) and as a client (requestor) - this is also called a peer

3.5.12

shield

[see 3.1.41]

3.5.13

simple class device

a device that replies to requests from Normal Class Devices and acts as a server or responder only

3.5.14

transmitter

[see 3.1.45]

3.6 **Type 6: *This subclause has been removed***

NOTE This subclause is a placeholder in this edition to minimize the disruption to existing national and multi-national standards and consortia documents that reference the subclause numbering of the prior edition.

3.7 **Type 8: Terms and definitions**

3.7.1

activity

[see 3.1.1]

3.7.2

bus coupler

a device that divides the ring into segments by opening the ring and integrating another ring at this point

3.7.3

cable plant interface connector (CPIC)

[see 3.1.5]

3.7.4

communication element

[see 3.1.6]

3.7.5

connector

[see 3.1.7]

3.7.6

dBm

[see 3.1.11]

3.7.7

effective launch power

[see 3.1.14]

3.7.8

effective power

[see 3.1.15]

3.7.9

fiber optic cable

[see 3.1.17]

3.7.10

fiber optic receiver

[see 3.1.19]

3.7.11

fiber optic receiver operating range

[see 3.1.20]

3.7.12

fiber optic transmitter

[see 3.1.21]

3.7.13

fiber optic waveguide

[see 3.1.22]

3.7.14

frame

[see 3.1.23]

3.7.15

incoming interface

interface to receive data from the previous device and to send data, which are received via an outgoing interface, to the previous device

3.7.16

isolation

[see 3.1.25]

3.7.17

local bus

a ring segment of a network with alternate media specifications, which is coupled to a remote bus via the bus coupler

3.7.18

local bus device

a device that operates as a slave on a local bus

3.7.19

master

a device that controls the data transfer on the network and initiates the media access of the slaves by sending messages and that constitutes the interface to the control system

3.7.20

medium

[see 3.1.29]

3.7.21

minimum optical receiver sensitivity

minimum optical power at the optical receiver input required to achieve a bit error rate of less than 10^{-9} for the optical transmission system

3.7.22

network

[see 3.1.30]

3.7.23

optical fall time

[see 3.1.32]

3.7.24

optical rise time

[see 3.1.34]

3.7.25

outgoing interface

interface to send data to the next slave in a way, that data that is received through this interface is sent via another outgoing interface to the next slave or via an incoming interface to the previous slave and back to the master

3.7.26

peak emission wavelength (λ_p)

[see 3.1.36]

3.7.27

polymer optical fiber

POF

plastic fiber optic waveguide whose nominal characteristics are compatible with IEC 60793 [fiber type: A4a (980/1000)]

3.7.28

plastic clad silica fiber

PCS

fiber optic waveguide consisting of a glass core and a plastic cladding and whose nominal characteristics are compatible with IEC 60793 [fiber type: A3c (200/230 μm)]

3.7.29

remote bus

a ring segment of a network

3.7.30

remote bus device

device operating as a slave on a remote bus

3.7.31

remote bus link

connection of two remote bus devices

3.7.32

ring segment

one section of a network

NOTE The master constitutes the first ring segment, further ring segments may be linked by bus couplers