SLOVENSKI STANDARD
SIST EN 61158-2:1998/A1:1998

01-november-1998

Fieldbus standard for use in industrial control systems - Part 2: Physical layer specification and service definition - Amendment 1 (IEC 61158-2:1993/A1:1995)

Fieldbus standard for use in industrial control systems -- Part 2: Physical layer specification and service definition

Feldbus für industrielle Leitsysteme -- Teil 2: Spezifikation der Bitübertragungsschicht (Physical layer) und Definition deren Dienste

Bus de Terrain utilisé dans les systèmes de contrôle industriels -- Partie 2: Spécification de la couche physique et définition du service

Ta slovenski standard je istoveten z: **EN 61158-2:1994/A1:1996**

ICS:

25.040.40	Merjenje in krmiljenje industrijskih postopkov	Industrial process measurement and control
35.100.10	Fizični sloj	Physical layer
35.110	Omreževanje	Networking

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EUROPEAN STANDARD

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English version

Fieldbus standard for use in industrial control systems Part 2: Physical layer specification and service definition (IEC 1158-2:1993/A1:1995)

Bus de Terrain utilisé dans les systèmes de contrôle industriels
Partie 2: Spécification de la couche physique et définition du service
(CEI 1158-2:1993/A1:1995)

Feldbus für industrielle Leitsysteme
Teil 2: Spezifikation der Bitübertragungsschicht (Physical layer) und Definition deren Dienste
(IEC 1158-2:1993/A1:1995)

This amendment A1 modifies the European Standard EN 61158-2:1994; it was approved by CENELEC on 1995-11-28. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment 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 amendment 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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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/143/DIS, future amendment 1 to IEC 1158-2:1993, prepared by SC 65C, Digital communications, of IEC TC 65, Industrial-process measurement and control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 61158-2:1994 on 1995-11-28.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-09-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) -

Annexes designated "informative" are given for information only.
In this standard, annexes D, E and F are informative.

Endorsement notice

The text of amendment 1:1995 to the International Standard IEC 1158-2:1993 was approved by CENELEC as an amendment to the European Standard without any modification.

NORME INTERNATIONALE
INTERNATIONAL STANDARD

CEI
IEC
1158-2

1993

AMENDEMENT 1
AMENDMENT 1

1995-11

Amendement 1

Bus de Terrain utilisé dans les systèmes de contrôle industriels –

Partie 2:
Spécification de la couche physique et définition du service

Amendment 1

Fieldbus standard for use in industrial control systems –

Part 2:
Physical layer specification and service definition

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FOREWORD

This amendment has been prepared by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

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

DIS	Report on voting
65C/143/DIS	65C/151/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.

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Add the titles of clauses 15, 16, 17 and 18 as follows:

15 Medium Attachment Unit (MAU): 31,25 kbit/s, single fibre mode, optical medium

16 Medium Attachment Unit (MAU): 31,25 kbit/s, dual fibre mode, optical medium

17 Medium Attachment Unit (MAU): 1,0 Mbit/s, dual fibre mode, optical medium

18 Medium Attachment Unit (MAU): 2,5 Mbit/s, dual fibre mode, optical medium

Add the titles of annexes D, E and F, as follows:

D Optical passive stars

E Star topology

F Alternate fibres

Add to the table list the titles of tables 27 to 46, as follows:

27 Transmit level and spectral specification summary for 31,25 kbit/s, single fibre mode, optical MAU

28 Transmit timing specification summary for 31,25 kbit/s, single fibre mode, optical MAU

29 Receive circuit specification summary for 31,25 kbit/s, single fibre mode, optical MAU

30 Transmit and receive level and spectral specifications for 31,25 kbit/s, single fibre mode, optical active star

31 Timing characteristics for a 31,25 kbit/s, single fibre mode, optical active star

32 Transmit level and spectral specification summary for 31,25 kbit/s, dual fibre mode, optical MAU

33 Transmit timing specification summary for 31,25 kbit/s, dual fibre mode, optical MAU

CONTENTS

Add to the figure list the titles of figures 37 to E.4, as follows:

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2 Normative references

Insert, in the existing list, the title of the following standard:

IEC 793-2: 1992, *Optical fibres – Part 2: Product specifications*

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Add, after subclause 14.7.7, the following new clauses 15, 16, 17 and 18:

15 Medium Attachment Unit (MAU): 31,25 kbit/s, single fibre mode, optical medium

15.1 *General*

15.1.1 *Object*

The object of this clause is to give the operating and optical specifications of the 31,25 kbit/s, single fibre mode, optical MAU. The transmitted bit rate shall be 31,25 kbit/s ± 0,2% average over a frame having a minimum length of 16 octets.

The network medium consists of a single optic waveguide. This fibre connects to the CPIC of a Fieldbus device. A fibre optic transmission system provides intrinsically safe proofing.

15.1.2 *Nomenclature*

Terms used in this clause are more specific than those defined in clause 3. The definitions of the terms are as follows:

15.1.2.1 **cable plant interface connector (CPIC):** The point at which test and conformance measurements are made. It is the interface between the Fieldbus device and the cable plant.

15.1.2.2 **dBm:** A measure of optical power. In terms of SI units (International System of Units), milliwatt (1 mW) is used as reference for expression in dB.

$$P_{dBm} = 10 \log \left(\frac{P\,mW}{1\,mW} \right)$$

15.1.2.3 **effective launch power:** The effective power coupled into the core of a fibre optic waveguide by the transmitter. This power is measured with a standard test fibre connected to the CPIC.

15.1.2.4 **effective power:** The difference, expressed in dBm, between the absolute optical power measured in milliwatts at the midpoint in time of the Hi level to the absolute optical power measured in milliwatts at the midpoint of the Lo level.

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

15.1.2.5 **elementary optical path:** Point to point link with a single fibre optic waveguide.

15.1.2.6 **extinction ratio:** The ratio of the absolute optical power measured in milliwatts at the midpoint in time of the Hi level to the absolute optical power measured in milliwatts 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 µW/1 mW), which equals -10,0 dBm. The extinction ratio is 105/5, which equals 21:1.

15.1.2.7 **fibre optic cable:** A cable containing one or more fibre optic waveguides. Jacketing material is provided to facilitate handling and to protect the fibre.

15.1.2.8 **fibre optic receiver:** The combined optics and electronics in the station that accept the optical signal received by the station through the CPIC.

15.1.2.9 **fibre optic receiver operating range:** The range of effective power that must be present at the CPIC to ensure that the bit error rate specifications are met.

15.1.2.10 **fibre optic transmitter:** A device that emits optical signals for propagation into a fibre optic waveguide through the CPIC.

15.1.2.11 **fibre optic waveguide:** A flexible, optically transparent strand that is used to transport optical signals from one geographic point to another geographic point.

15.1.2.12 **typical half-intensity wavelength (Δλ):** Range of wavelength of spectral distribution in which the radiant intensity is no less than one-half of the maximum intensity.

15.1.2.13 **jitter:** The offset of the 50 % transition points of pulse edges from their ideal position as the result of all causes.

15.1.2.14 **optical passive star:** A passive device, in which a signal from input fibres is distributed among output optical fibres.

15.1.2.15 **optical active star:** An active device which receives a signal, amplifies it and retransmits it (retiming is optional). This element requires electrical power to operate.

15.1.2.16 **optical fall time:** The time it takes for a pulse to go from 90 % effective power to 10 % effective power. The fall time is specified as a per cent of the nominal bit time.

15.1.2.17 **optical rise time:** The time it takes for a pulse to go from 10 % effective power to 90 % effective power. The rise time is specified as a per cent of the nominal bit time.

15.1.2.18 **peak emission wavelength (λp):** Wavelength at which radiant intensity is maximized.

15.1.2.19 **standard test fibre:** A silica fibre optic waveguide whose nominal characteristics are compatible with IEC 793-2 [fibre type: A1d (100/140)].

Test fibre characteristics are given in 15.6.2. The length of the standard test fibre is 1 m.

15.2 *Network specifications*

NOTE – A 31,25 kbit/s, single fibre mode, optical MAU operates in a network made up of the following components:

a) optical cable;

b) devices (containing at least one communication element);

c) connectors;

d) optical passive stars;

e) optical active stars.

15.2.1 *Topologies*

An optical MAU shall operate in a network with a star topology. Devices are connected to the optical stars by elementary optical paths. Optical active stars are interconnected by elementary optical paths.

15.2.2 *Network configuration rules*

Rule 1: all network devices operate at the same bit rate.

Rule 2: the total number of optical active stars between any two devices shall not exceed four.

Rule 3: the maximum propagation delay between any two devices shall not exceed 20 nominal bit times.

NOTE – For network efficiency, the part of the turn-around time of any device on the network caused by a PhE between the end of a received frame and the beginning of the transmitted frame containing an associated immediate response should not exceed five bit times, no more than two bit times of which should be due to the MAU. As it is not mandatory to expose the DLL-PhL interface or the MDS-MAU interface, that part of the turn-around time of a Fieldbus device caused by the PhL or the MAU cannot be specified, or conformance tested.

Rule 4: the Fieldbus shall be capable of continuing operation while a device is being connected or disconnected. Data errors induced during connection or disconnection shall be detected.

Rule 5: the network configuration shall not have a closed loop. The path between any two devices is single.

Rule 6: the following rules shall apply to systems implemented with redundant media:

a) each channel shall comply with the network configuration rules;

b) there shall not be a non-redundant segment or equipment between two redundant segments;

c) optical active stars shall be redundant;

d) if the system is configured (by Station Management) to transmit on more than one channel simultaneously then the propagation time difference between any two devices on any two channels shall not exceed five bit times.

e) channel numbers shall be maintained throughout the Fieldbus, i.e. channels 1,2,3... from Station Management shall always connect to physical channels 1,2,3...

f) If the system is configured (by Station Management) to transmit only one channel, any associated response shall be transmitted on the same channel.

15.3 *Transmit circuit specifications*

NOTE – For ease of reference, the requirements of 15.3 are summarized in tables 27 and 28.

15.3.1 *Test configuration*

The output level, spectral and timing specifications are measured at the end of 1 m standard test fibre connected to the CPIC.

15.3.2 *Output level specification*

A 31,25 kbit/s, single fibre mode, optical MAU transmit circuit shall conform to the following output level and spectral requirements. Level and spectral characteristics are measured at a temperature of 25 °C. Output level is the effective launch power of a Hi level. Output level specification is shown in table 27.

NOTE – For ease of reference, the requirements of 15.3.2 are summarized in table 27.

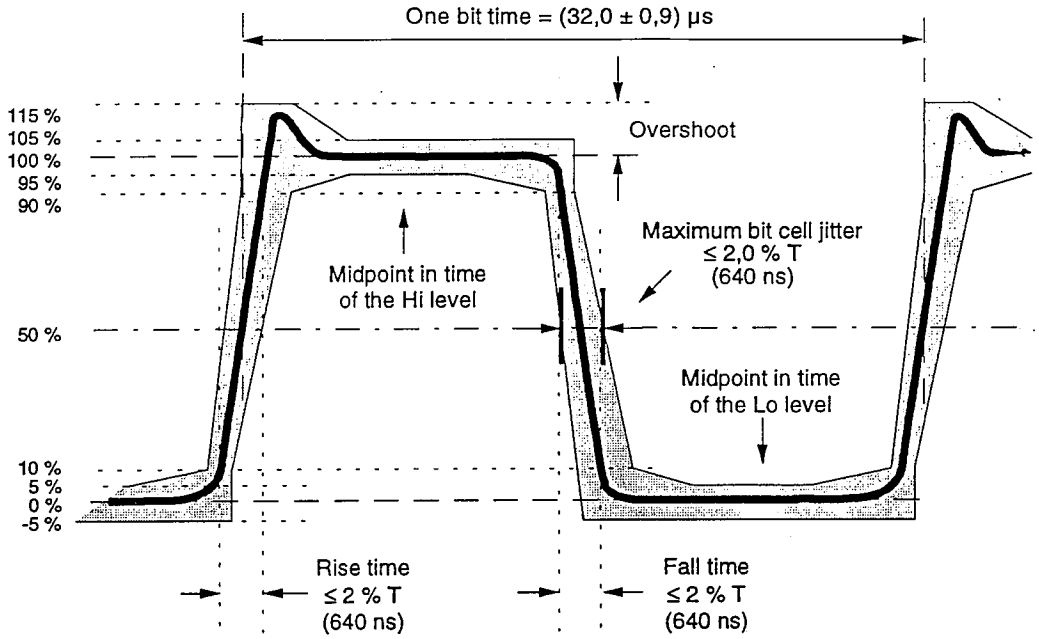
Table 27 – Transmit level and spectral specification summary for 31,25 kbit/s, single fibre mode, optical MAU

Transmit level and spectral characteristics (values referred to the CPIC with standard test fibre)	Limits for 31,25 kbit/s (100/140 µm fibre)
Peak emission wavelength (λp)	(850 ± 30) nm
Typical half-intensity wavelength (Δλ)	≤50 nm
Effective launch power Hi level	(–13,5 ± 1,0) dBm
Overshoot of transitions	≤15 % effective power
Extinction ratio	≥20:1

15.3.3 *Output timing specification*

A 31,25 kbit/s, single fibre mode, optical MAU transmit circuit shall conform to the following output timing requirements (figure 37).Timing characteristics are measured at a temperature of 25 °C.

NOTE – For ease of reference, the requirements of 15.3.3 are summarized in table 28.



Note - 0 % effective power is the Lo level state power level.

100 % effective power is the Hi level state power level.

Figure 37 – Optical wave shape template, 31,25 kbit/s, single fibre mode, optical MAU

Table 28 – Transmit timing specification summary for 31,25 kbit/s, single fibre mode, optical MAU

Transmit timing characteristics (values referred to the CPIC with standard test fibre)	Limits for 31,25 kbit/s
Transmitted bit rate (31,25 kbit/s optical MAU)	31,25 kbit/s ± 0,2%
Instantaneous bit time (31,25 kbit/s)	(32 ± 0,9) µs
Rise and fall times (10 % to 90 % of peak-peak signal)	≤2,0 % nominal bit time
Difference between rise and fall times	≤0,5 % nominal bit time
Maximum transmitted bit cell jitter	±2,0 % nominal bit time

15.4 *Receive circuit specifications*

NOTE – For ease of reference, the requirements of 15.4 are summarized in table 29.

15.4.1 *Receiver operating range*

The specified receiver sensitivity range is:

–30,0 dBm to –12,5 dBm effective power for low sensitivity;

–40,0 dBm to –20,0 dBm effective power for high sensitivity.

15.4.2 *Maximum received bit cell jitter*

The receive circuit shall accept a Manchester encoded signal transmitted in accordance with 15.3. In addition, the receiver shall accept signals with the time variation between any two adjacent signal transition points (50 % crossing) of ± 14,0 % nominal bit time or less.

NOTES

1 This does not preclude the use of receivers which perform better than this specification but in accordance with the tolerance of the received bit cell jitter of the MDS (See 9.5).

2 Depending on the symbol pattern, the nominal time between 50 % crossing may be half of one bit time or one bit time.

15.4.3 *Interference susceptibility and error rates*

NOTE – When the Fieldbus is operating in a variety of standard noise environments, the probability that an Application Layer User Data Unit contains an undetected error, due to operation of the conveying Physical and Data Link Layer entities, should be less than 1 in 6 x 10^9 (one error in 20 years at 10 messages/s). A communication element is regarded as conforming to this theoretical requirement when it meets the following interference susceptibility requirements. These are specified by a detected frame error rate which is derived by using a ratio of detected to undetected errors of 10^6. This follows the IEEE 802 Functional requirements document draft 5.9, clauses 5.6.1 and 5.6.2 and should be readily achievable with a 16 bit frame check sequence at the Data Link Layer.

A communication element which includes a 31,25 kbit/s, single fibre mode, optical MAU operating with frames containing 32 random user data bits, at an average of 10 messages/s, with signals of -25 dBm, shall produce no more than 10 detected frame errors in 60 000 frames during operation in the presence of electromagnetic or electrical interference environments as follows:

a) 10 V/m electromagnetic field as specified in IEC 801-3 at severity level 3;

b) electrical fast transient as specified in IEC 801-4 at severity level 3.

The above error rate specifications shall also be satisfied after, but not during, operation in the following noise environments:

1) 8 kV electrical discharge to exposed metalwork as specified in IEC 801-2 at severity level 3. If the device suffers temporary loss of function or performance as a result of this test it shall recover from any such loss without operator intervention within 3 s after the end of the test;