SLOVENSKI STANDARD
oSIST ISO 21111-4:2022

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Cestna vozila - Ethernet v vozilu

Road vehicles - In-vehicle Ethernet

Véhicules routiers - Ethernet embarqué

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Road vehicles — In-vehicle Ethernet —

Part 4: General requirements and test methods of optical gigabit Ethernet components

Véhicules routiers — Ethernet embarqué —

Partie 4: Exigences générales et méthodes de test des composants optiques pour l'Ethernet gigabit

Reference number
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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

A list of all parts in the ISO 21111 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO 21111 series includes in-vehicle Ethernet requirements and test plans that are disseminated in other International Standards and complements them with additional test methods and requirements. The resulting requirement and test plans are structured in different documents following the Open Systems Interconnection (OSI) reference model and grouping the documents that depend on the physical media and bit rate used.

In general, the Ethernet requirements are specified in ISO/IEC/IEEE 8802-3. The ISO 21111 series provides supplemental specifications (e.g. wake-up, I/O functionality), which are required for in-vehicle Ethernet applications. In road vehicles, Ethernet networks are used for different purposes requiring different bit-rates. Currently, the ISO 21111 series specifies the 1-Gbit/s optical and 100-Mbit/s electrical physical layer.

The ISO 21111 series contains requirement specifications and test methods related to the in-vehicle Ethernet. This includes requirement specifications for physical layer entity (e.g. connectors, physical layer implementations) providers, device (e.g. electronic control units, gateway units) suppliers, and system (e.g. network systems) designers. Additionally, there are test methods specified for conformance testing and for interoperability testing.

Safety (electrical safety, protection, fire, etc.) and electromagnetic compatibility (EMC) requirements are out of the scope of the ISO 21111 series.

The structure of the specifications given in the ISO 21111 series complies with the Open Systems Interconnection (OSI) reference model specified in ISO/IEC 7498-1[13] and ISO/IEC 10731[14].

ISO 21111-1 defines the terms which are used in this series of standards and provides an overview of the standards for in-vehicle Ethernet including the complementary relations to ISO/IEC/IEEE 8802-3, the document structure, type of physical entities, in-vehicle Ethernet specific functionalities and so on.

ISO 21111-2 specifies the interface between reconciliation sublayer and physical entity including reduced gigabit media independent interface (RGMII), and the common physical entity wake-up and synchronized link sleep functionalities, independent from physical media and bit rate.

ISO 21111-3 specifies supplemental requirements to a physical layer capable of transmitting 1-Gbit/s over plastic optical fibre compliant with ISO/IEC/IEEE 8802-3, with specific application to communications inside road vehicles, and a test plan for physical entity conformance testing.

This document specifies the optical components requirements and test methods for 1-Gbit/s optical in-vehicle Ethernet.

ISO 21111-5 specifies, for 1-Gbit/s optical in-vehicle Ethernet, requirements on the physical layer at system level, requirements on the interoperability test set-ups, the interoperability test plan that checks the requirements for the physical layer at system level, requirements on the device-level physical layer conformance test set-ups, and device-level physical layer conformance test plan that checks a set of requirements for the OSI physical layer that are relevant for device vendors.

ISO 21111-6 specifies advanced features of an ISO/IEC/IEEE 8802-3 in-vehicle Ethernet physical layer (often also called transceiver), e.g. for diagnostic purposes for in-vehicle Ethernet physical layers. It specifies advanced physical layer features, wake-up and sleep features, physical layer test suite, physical layer control requirements and conformance test plan, physical sublayers test suite and physical sublayers requirements and conformance test plan.

ISO 21111-7 specifies the implementation for ISO/IEC/IEEE 8802-3:2017/Amd 1:2017, which defines the interface implementation for automotive applications together with requirements on components used to realize this Bus Interface Network (BIN). ISO 21111-7 also defines further testing and system requirements for systems implemented according to the system specification. In addition, ISO 21111-7 defines the channels for tests of transceivers with a test wiring harness that simulates various electrical communication channels.

ISO 21111-8 specifies the transmission media, the channel performance and the tests for ISO/IEC/IEEE 8802-3 in-vehicle Ethernet.

ISO 21111-9 specifies the data link layer requirements and conformance test plan. It specifies the requirements and test plan for devices and systems with bridge functionality.

ISO 21111-10 specifies the application to network layer requirements and test plan. It specifies the requirements and test plan for devices and systems that include functionality related with OSI layers from 3 to 7.

Figure 1 shows the parts of the ISO 21111 series and the document structure.

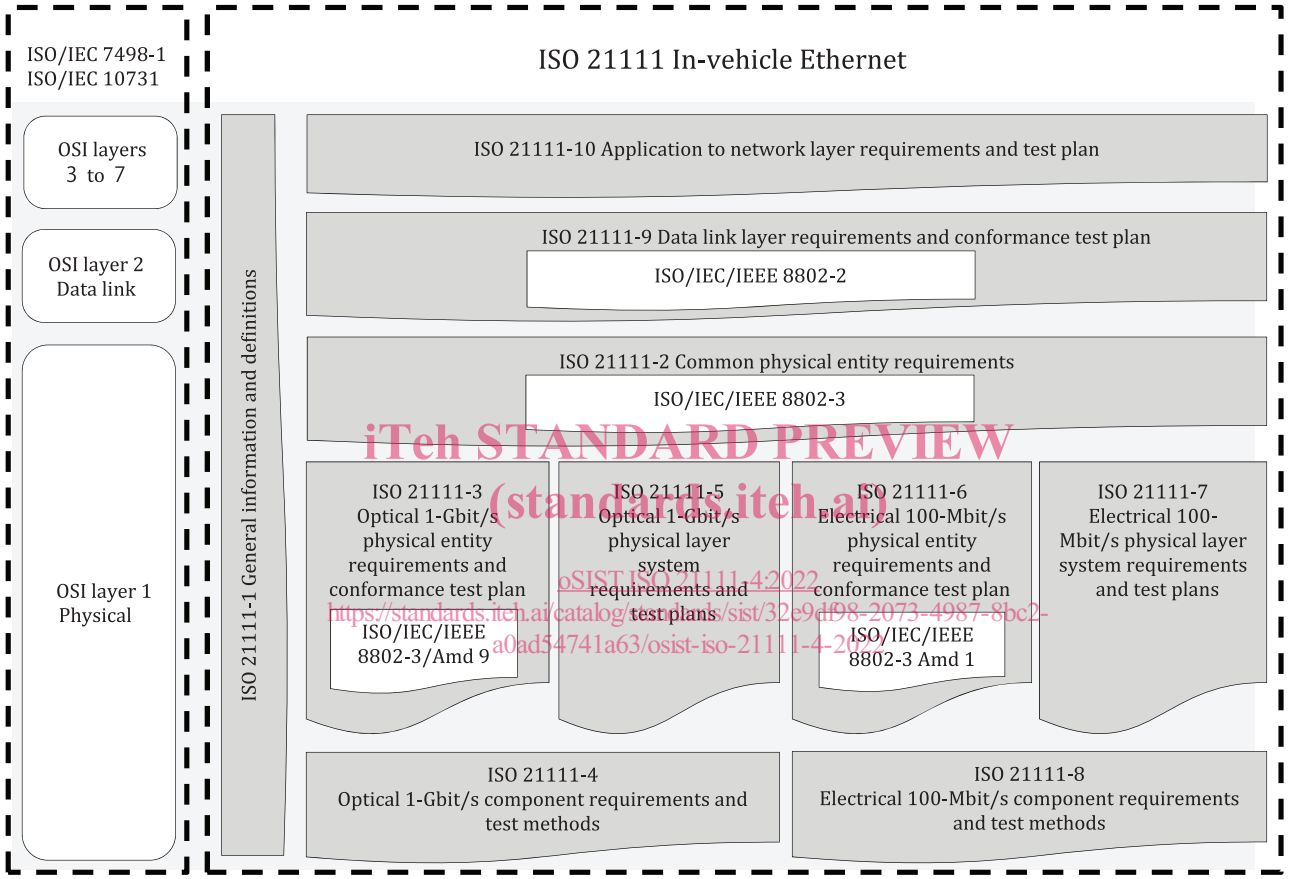


Figure 1 — In-vehicle Ethernet document reference according to OSI model

Road vehicles — In-vehicle Ethernet —

Part 4: General requirements and test methods of optical gigabit Ethernet components

1 Scope

This document specifies the optical components requirements and test methods for optical gigabit transmission of in-vehicle Ethernet. Safety (electrical safety, protection, fire, etc.) and electromagnetic compatibility (EMC) requirements are outside the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO/IEC/IEEE 8802-3:2017/Amd 9:2018, *Physical Layer Specifications and Management Parameters for 1000 Mb/s Operation over Plastic Optical Fibre*

ISO 8092-2, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 2: Definitions, test methods and general performance requirements*

ISO 8092-3, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 3: Tabs for multi-pole connections — Dimensions and specific requirements*

ISO 16750-1, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

ISO 16750-3:2012, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads*

ISO 16750-4:2010, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads*

ISO 16750-5, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads*

ISO 21111-1, *Road vehicles — In-vehicle Ethernet —General information and definitions*

IEC 60068-2-60, *Environmental testing — Part 2: Tests — Test Ke: Flowing mixed gas corrosion test*

IEC 60793-1-20, *Optical fibres — Part 1-20: Measurement methods and test procedures — Fibre geometry*

IEC 60793-1-21, *Optical fibres — Part 1-21: Measurement methods and test procedures — Coating geometry*

IEC 60793-1-40, *Optical fibres — Part 1-40: Attenuation measurement methods*

IEC 60793-2-40, *Optical fibres — Part 2-40: Product specifications — Sectional specification for category A4 multimode fibres*

IEC 60793-1-43, *Optical fibres — Part 1-43: Measurement methods and test procedures — Numerical aperture measurement*

IEC 60793-1-51, *Optical fibres — Part 1-51: Measurement methods and test procedure – Dry heat (steady state) tests*

IEC 60794-1-21, *Optical fibre cables — Part 1-21: Generic specification — Basic optical cable test procedures — Mechanical tests methods*

IEC 60794-2-41, *Optical fibre cables — Part 2-41: Indoor cables — Product specification for simplex and duplex buffered A4 fibres*

IEC 61300-3-53, *Fibre optic interconnecting devices and passive components — Basic test and measurement procedures — Part 3-53: Examinations and measurements — Encircled angular flux (EAF) measurement method based on two-dimensional far field data from step index multimode waveguide (including fibre)*

ANSI/EIA 364-13, *Mating and Un-mating Force Test Procedure for Electrical Connectors and Sockets*

EIA 364-38, *Cable pull-out test procedure for electrical connectors*

EIA/TIA 455-13A, *Visual and mechanical inspection of fibre optic components, devices, and assemblies*

EIA/TIA 455-20A, *Measurement of Change in Optical Transmittance*

EIA/TIA 455-34A, *Interconnection Device Insertion Loss Test*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21111-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
1000BASE-H
physical coding sublayer (PCS) and physical medium attachment (PMA) sublayers for 1 000 Mb/s Ethernet that support physical medium dependent (PMD) using duplex plastic optical fibre

3.2
1000BASE-RHC
physical layer specification for 1 000 Mb/s Ethernet using *1000BASE-H* (3.1) encoding and red light (approximately 650 nm) PMD tailored for automotive application requirements

3.3
extinction ratio
ER
ratio of two optical power levels of a digital signal generated (high or low) by an optical source

3.4
FORx
part of an *optical PMD receiver* (3.10) that includes a photo detector and an amplifier

3.5
FOTx
part of an *optical PMD transmitter* (3.12) that includes a light emitting device and a driver

3.6
in-line connector
connector resulting of the match of a cable plug and a cable socket

3.7
launch optics
light source with some additional optical components

3.8
mode filter
optical filter that eliminates higher order modes in order to suppress modal dispersion

3.9
mode scrambler
optical component defined in IEC 60793-2-40

3.10
optical PMD receiver
receiver optical front end composed of a photo detector, an amplifier and a *waveguide* (3.15) for optical coupling

3.11
optical PMD transceiver
optical front end composed of an *optical PMD receiver* (3.10) and an *optical PMD transmitter* (3.12)

3.12
optical PMD transmitter
transmitter optical front end composed of a light emitting device, a driver and *waveguide* (3.15) for optical coupling

3.13
passive component
module that does not require energy to operate

Note 1 to entry: POF cable or optical connector as defined in Clause 7 is in this category.

3.14
system power budget
allocation of available optical power in order to ensure that adequate signal strength is available at the receiver

Note 1 to entry: As defined in A.2.

3.15
waveguide
optical coupling device that is set between the end face of POF and the optical window of the LED or Photodiode

4 Abbreviated terms

AOP	average optical power
DUT	device under test
EAF	encircled angular flux
FFP	far field pattern
FOT	fibre optic transceiver
GEPOF	gigabit ethernet over plastic optical fibre
I/F	interface

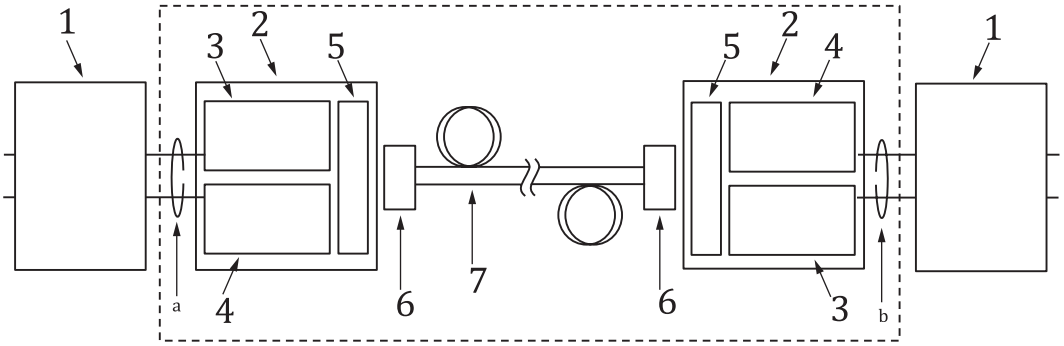
LD	laser diode
LED	light emitting diode
MDI	media dependent interface
MRP	mechanical reference plane
NA	numerical aperture
ORP	optical reference plane
PCB	printed circuit board
PCS	physical coding sublayer
PMA	physical media attachment
PMD	physical media dependent
POF	plastic optical fibre

5 1000BASE-RHC components

Figure 2 specifies the components used for the connection between two GEPOF entities that conform to the ISO 21111 series. The 1000BASE-H transceiver component includes the functionality described for the 1000BASE-H transmitter and receiver defined in ISO/IEC/IEEE 8802-3:2017/Amd 9 and for the GEPOF entity in ISO 21111-3. The optical PMD transceiver component includes the functionality described for the optical PMD transmitter and receiver defined in ISO/IEC/IEEE 8802-3:2017/Amd 9 and optical coupling elements defined in this document. These elements are enclosed in broken line in Figure 2.

A GEPOF entity may be integrated in a single component that includes the 1000BASE-H transceiver, the optical PMD transceiver and the cable socket. The resulting component is defined as integrated header connector. In an alternative configuration, the GEPOF entity may be implemented by using two different components. The first one includes the 1000BASE-H transceiver and the second one integrates the optical PMD transceiver and the cable socket. The resulting component is defined as header connector.

Two GEPOF entities are connected through their MDI bi-directionally through a duplex POF cable or a pair of simplex POF cables (see 8.4). The POF cable is terminated with two cable plugs that fulfils the characteristics defined in Clause 9. The connection between two GEPOF entities may include or not one or more in-line connectors.



Key

1 1000BASE-H transceiver
2 header connector
3 optical PMD transmitter
4 optical PMD receiver
5 mechanics for axis alignment
6 cable plug
7 POF cable
a Electrical I/F between PMA and PMD.
b Electrical I/F between PMD and PMA.

Figure 2 — 1000BASE-RHC components

6 Header connector

6.1 Dimension criteria

Two types of header connector are defined.

Type A header connector is defined in Figure 3 and type B header connector is defined in Figure 4. MRP is used to determine a mechanical position when a header connector and a plug connector are mated. Additionally, ORP is used to determine an optical position for the efficient optical coupling performance. The detail H and J of type A and the detail C of type B specify the position of the tip of ferrule of the cable plug in mated condition.

— Type A

A type A header connector shall comply with the dimensions and tolerances defined in Figure 3.