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REDLINE VERSION

Industrial networks - Ethernet-APL port profile / Ethernet-SPE profile specification

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Industrial networks - Ethernet-APL port profile / Ethernet-SPE profile specification

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC TS 63444:2023. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC TS 63444 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is a Technical Specification.

This second edition cancels and replaces the first edition published in 2023. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) new power class for Ethernet-APL;

b) addition of Ethernet-SPE;

c) clarification of usability of Ethernet-APL in non-hazardous locations.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
65C/1386/DTS	65C/1411/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

IEEE Std 802.3™-2022, Clause 146, specifies the Ethernet Physical Layer 10BASE-T1L, suitable to be used for full-duplex communication over a single balanced pair of conductors.

This physical layer is specifically designed for industrial applications, supporting the main requirements for advanced, robust process control and monitoring in safe or hazardous areas.

The primary physical layer solution focuses on four requirements:

– support of single pair cables providing both communication and optional power;
– increased data bandwidth, 10 Mbit/s;
– support of extended Ethernet cable length of up to 1 km;
– support of intrinsically safe protection for use in hazardous areas.

IEEE Std 802.3-2022, Clause 146, only specifies the digital communication method and its electrical characteristics. To ~~assure~~ achieve interoperability between the various interconnected components at different parts of the network, a further set of specifications and classifications are supportive when applying this new physical layer for industrial applications ~~requires a further set of specifications and classifications. The "Ethernet Advanced Physical Layer" (Ethernet-APL or APL) references and standardizes industrial automation extensions.~~

In addition, IEEE Std 802.3™-2022, Clause 104, as corrected and amended by IEEE Std 802.3dd-2022 specifies the Power over Data Lines (PoDL) of Single-Pair Ethernet. This clause specifies two optional power entities. These entities allow devices to supply or draw power using the cabling that may be used for data transmission. PoDL does not support intrinsic safety and is optimized for applications that do not require intrinsic safety.

The "Ethernet Advanced Physical Layer" (Ethernet-APL or APL) standardizes 2-wire (single-pair) industrial Ethernet supporting the "2-WISE" (IEC TS 60079-47) intrinsically safe concept. Clause 146 is referenced and extended, and Clause 104 is replaced with an alternate power method. Ethernet-SPE standardizes non-intrinsically safe single-pair industrial Ethernet for process automation, factory automation and building automation. Clause 146 and Clause 104 (PoDL) are referenced and extended. Ethernet-SPE can be used in combination with Ethernet-APL.

The first part of this document specifies 2-WISE compliant Ethernet-APL port profiles for use in hazardous and non-hazardous ~~areas,~~ with and without power. Ethernet-APL intrinsically safe profiles facilitate the examination of the interconnection of different Ethernet-APL ports. Most common industrial rated connectors for use in process industries are part of this document. A multi-length cable category system maintains communication integrity, while permitting cable constructions optimized for specific applications or environmental ratings. The second part of this document specifies Ethernet-SPE profiles without intrinsic safety for use in non-hazardous locations, with and without power. This also includes hazardous locations not requiring intrinsic safety.

Ethernet-APL and Ethernet-SPE impact the various physical layers in IEC 61158-2 and its associated Types. This document provides a neutral approach for the new Advanced Physical Layer which can be then transferred to the next editions of different IEC intrinsically safe fieldbus documents. The following documents are representative of potentially affected next editions: IEC 61158-2, the IEC 61784-1 series, the IEC 61784-2 series, IEC 61918 and the IEC 61784-5 series.

This document is not intended to assure interoperability at the product level but only at the port level. No reference is made to any Ethernet-based communication protocol above the physical layer.

NOTE 1 As a simplification, this document describes some applications as 'requiring 2-WISE'. Ethernet-APL supports intrinsic safety with 2-WISE can suit these applications. This document describes other applications as 'not requiring 2-WISE'. Ethernet-SPE does not support intrinsic safety (and therefore not 2-WISE) and suits these applications (Ethernet-APL can also be used).

NOTE 2 Heating of cable due to remote powering is not considered in this document. Information is supplied by ISO/IEC TS 29125.

1 Scope

This document is applicable to process automation equipment using a 10BASE-T1L compliant ~~(see IEEE Std 802.3-2022, Clause 146)~~ Physical Layer (PHY). Ethernet-APL intrinsically safe profiles with different predefined entity or limitation parameters (for example voltage, current, power, capacitance, inductance, cable length) simplify the examination of the interconnection of different Ethernet-APL ports. Furthermore, this document is also applicable to factory and building automation and control equipment using a 10BASE-T1L compliant, and Power over Data Lines (PoDL) compliant Physical Layer (PHY) for non-intrinsically safe Ethernet installations.

NOTE In this document the term Ethernet-SPE is used for PoDL compliant PHY.

The following technical features are part of this document:

– topology with trunk~~/~~ and spur installation capability;
– 2-wire technology (full-duplex communication data rate of 10 Mbit/s);
– long distance (refers to cable lengths of several hundred meters, with spans up to 1 000 m);
– intrinsic safety (installation of Ethernet-capable field devices in hazardous areas);
– power supply to field devices over the same 2-wire cable used for data communication;
– non-intrinsically safe Ethernet installation in factory and building automation.

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.

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

IEC 60079-14, *Explosive atmospheres - Part 14: Electrical installations design, selection and ~~erection~~ installation of equipment, including initial inspection*

IEC 60079-25, *Explosive atmospheres - Part 25: Intrinsically safe electrical systems*

IEC TS 60079-47:2021, *Explosive atmospheres - Part 47: Equipment protection by 2-wire intrinsically safe ethernet concept (2-WISE)*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements*

IEC 61076-2-101, *Connectors for electronic equipment - Product requirements - Part 2-101: Circular connectors - Detail specification for circular connectors for M12 connectors with screw-locking*

IEC 61076-2-104, *Connectors for electronic equipment - Product requirements - Part 2-104: Circular connectors - Detail specification for circular connectors with M8 screw-locking or snap-locking*

IEC 61156-13, *Multicore and symmetrical pair/quad cables for digital communications - Part 13: Symmetrical single pair cables with transmission characteristics up to 20 MHz - Horizontal floor wiring - Sectional specification*

IEC 61156-14, *Multicore and symmetrical pair/quad cables for digital communications - Part 14: Symmetrical single pair cables with transmission characteristics up to 20 MHz - Work area wiring - Sectional specification*

IEC 61158-2:2023, *Industrial communication networks - Fieldbus specifications - Part 2: Physical layer specification and service definition*

IEC 61643-21, *Low voltage surge protective devices - Part 21: Surge protective devices connected to telecommunications and signalling networks - ~~Performance~~ Requirements and ~~testing~~ test methods*

IEC 63171:2025, *Connectors for electrical and electronic equipment - Shielded or unshielded free and fixed connectors for balanced single-pair data transmission with current-carrying capacity - General requirements and tests*

ISO/IEC 11801-1:2017, *Information technology - Generic cabling for customer premises - Part 1: General requirements*
ISO/IEC 11801-1:2017/AMD1:2025

IEEE Std 802.3-2022, *IEEE Standard for Ethernet*

~~ASTM D4566-05, *Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable*; available at < ASTM D4566-05 - Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable (ansi.org)> [viewed 2023-10-13]~~

IEEE Std 802.3dd-2022, *IEEE Standard for Ethernet, Amendment 1: Power over Data Lines of Single Pair Ethernet*

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
Advanced Physical Layer
APL
physical layer based on 10BASE-T1L according to IEEE Std 802.3-2022 with additional optional features like intrinsic safety, power over 2 wires

Note 1 to entry: Additional requirements for use in process industries are specified in this document.

3.1.2
APL segment
segment that consists of two APL ports, each containing a 10BASE-T1L compatible PHY, connected at each end of a two-wire, shielded cable

Note 1 to entry: An APL segment can optionally be equipped with a maximum of two auxiliary devices and can contain up to 10 inline terminal connections. An auxiliary device corresponds to one inline connection; for example, having two auxiliary devices connected to one APL segment will reduce the number of inline connections by two.