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TECHNICAL REPORT

Information technology – Generic cabling for customer premises – Part 9906: Balanced 1-pair cabling channels up to 600 MHz for single pair Ethernet (SPE)

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FOREWORD

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ISO/IEC TR 11801-9906, which is a Technical Report, was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 11801 series, under the general title *Information technology – Generic cabling for customer premises*, can be found on the IEC and ISO websites.

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

Draft TR	Report on voting
JTC1-SC25/2888/DTR	JTC1-SC25/2913/RVDTR

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

INTRODUCTION

This document is a compendium of balanced 1-pair cabling channels specifications related to specific applications.

The balanced 1-pair cabling channels support single-pair Ethernet (SPE) applications, according to ISO/IEC/IEEE 8802-3:2017/AMD4, 1000BASE-T1; ISO/IEC/IEEE 8802-3:2017/AMD1, 100BASE-T1; and IEEE 802.3cg, 10BASE-T1.

While the original use case for SPE was automotive applications, this document describes balanced 1-pair cabling channels intended for use in non-automotive, SPE applications – for example:

- industrial automation applications, Industrial Internet of Things (IIoT), Industry 4.0;
- enterprise building applications, Internet of Things (IoT), smart lighting, energy management, and access control;
- other IoT applications, smart building and home automation applications.

SPE cabling channels support bidirectional signal transmission, using one balanced pair, for 1 000 Mbit/s (ISO/IEC/IEEE 8802-3:2017/AMD4) up to 40 m, 100 Mbit/s (ISO/IEC/IEEE 8802-3:2017/AMD1) up to 15 m, or 10 Mbit/s (IEEE 802.3cg) up to 1 000 m, where reach is influenced by cabling channel capacity limitations from signal loss and electromagnetic interference.

SPE channels optionally support power delivery together with the signal delivery over a single balanced pair. Remote powering over balanced 1-pair cabling is addressed in ISO/IEC TS 29125:2017/AMD1[1].

[1] To be published. Stage at the time of publication: ISO/IEC DTS 29125:2017/AMD1:2019.

INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES –

Part 9906 – Balanced 1-pair cabling channels up to 600 MHz for single pair Ethernet (SPE)

1 Scope

This document covers channel specifications, for channels constructed from balanced 1-pair cabling components, primarily intended for use in industrial automation and process control applications.

The channel specifications are consistent with corresponding IEEE 802.3 single-pair Ethernet (SPE) applications and are referenced from link segment specifications in the following IEEE SPE physical layer specifications:

- ISO/IEC/IEEE 8802-3:2017/AMD4, 1 000 Mb/s: 1000BASE-T1 Type A, ≤ 15 m, 1000BASE-T1 Type B, ≤ 40 m;
- ISO/IEC/IEEE 8802-3:2017/AMD1, 100 Mb/s: 100BASE-T1, ≤ 15 m;
- IEEE 802.3cg, 10 Mb/s: 10BASE-T1S, ≤ 15 m; 10BASE-T1L, ≤ 1 000 m.

The channel component specifications are referenced according to corresponding IEC balanced 1-pair cable and connector specifications.

Channel specifications include IL, RL, TCL, coupling attenuation, and alien crosstalk parameters specifications.

Channel EMC related specifications include electromagnetic isolation levels E_1, E_2 and E_3, which are defined according to the MICE standard environmental characterization system specified in ISO/IEC 11801-1.

2 Normative references

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

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11801-1 and the following apply.

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

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

3.1.1
balanced 1-pair cabling channel
cabling channel constructed from balanced 1-pair cables, balanced 1-pair connectors and balanced 1-pair cord to form a cabling channel intended for use in differential-mode signal transmission and power delivery applications

3.1.2
balanced 1-pair cable
cable consisting of a single pair of conductors, optional screen, and overall jacket, primarily intended for use in differential-mode signal transmission and power delivery applications

3.1.3
balanced 1-pair connector
connector intended for use with balanced 1-pair cable in differential-mode signal transmission and power delivery applications

3.1.4
balanced 1-pair cord
cable assembly constructed from a 1-pair cable and 1-pair connectors

3.2 Symbols

V_{pp} peak-to-peak voltage

4 Balanced 1-pair cabling channels

4.1 General

Channel signal transmission specifications for balanced 1-pair cabling are referenced from three physical layer specifications: ISO/IEC/IEEE 8802-3:2017/AMD1, ISO/IEC/IEEE 8802-3:2017/AMD4 and IEEE802.3cg. These cover five link segment specifications: 1000BASE-T1 Type A, 1000BASE-T1 Type B, 100BASE-T1, 10BASE-T1S, and 10BASE-T1L. IEEE SPE link segment specifications and physical layer standards are summarized in Annex C.

The SPE link segment specifications are identified by their corresponding upper frequency specification, i.e. 600 MHz, 66 MHz, and 20 MHz.

The SPE signal transmission functional space covered by the five link segment specifications is given in Table 1.

Table 1 – SPE signal transmission functional space

Upper frequency	Frequency range	Reach	Screen	Data rate	SPE link segment	IEEE physical layer
MHz	MHz	m	**Type**	Mb/s	**Specification**	**Standard**
600	$1 \le f \le 600$	15	Screened and unscreened	1 000	1000BASE-T1 Type A	ISO/IEC/IEEE 8802-3:2017/ AMD4
600	$1 \le f \le 600$	40	Screened	1 000	1000BASE-T1 Type B	ISO/IEC/IEEE 8802-3:2017/ AMD4
66	$0,3 \le f \le 66$	15	Unscreened	100	100BASE-T1	ISO/IEC/IEEE 8802-3:2017/ AMD1
20	$0,1 \le f \le 20$	15	Screened and unscreened	10	10BASE-T1S	802.3cg
20	$0,1 \le f \le 20$	1 000	Screened and unscreened	10	10BASE-T1L	802.3cg

NOTE Limits involving more than 1 pair within a channel; the following parameters are not applicable to balanced 1-pair cabling channels: NEXT, PS NEXT, ACR-F, PS ACR-F, ACR-N, PS ACR-N, delay skew and pair-to-pair resistance unbalance.

4.2 Component specifications

Balanced 1-pair cabling channel characteristics are specified using balanced 1-pair cabling component specifications. Balanced 1-pair cable and connector component specification references are given in Annex A and Annex B, respectively.

The characteristics of a channel are specified between connections to active equipment. The channel comprises only passive sections of cable, connecting hardware and cords. The connections at the hardware interface to active equipment are not taken into account.

Application support depends on channel performance, which in turn depends on cable length, number of connections, connector termination practices, workmanship and performance. It is possible to achieve equivalent channel performance over greater lengths by the use of fewer connections or by using components with higher performance.

Considerations for balanced 1-pair channels bundled in a 4-pair cabling channel are given in Annex D.

4.3 Environmental classifications

ISO/IEC 11801-1 classifies the environments for generic cabling according to three "MICE" levels.

The balanced 1-pair cabling specifications referenced in ISO/IEC/IEEE 8802-3:2017/AMD1, ISO/IEC/IEEE 8802-3:2017/AMD4 and IEEE 802.3cg include channel EMC related specifications for electromagnetic isolation levels E_1, E_2 and E_3, which are defined according to the MICE standard environmental characterization system specified in ISO/IEC 11801-1.

The channel EMC related specifications are unbalance attenuation, coupling attenuation, and alien (exogenous) crosstalk, which are specified for channels and components per E_1, E_2 and E_3.