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TECHNICAL REPORT

Information technology – Generic cabling for customer premises – Part 9907: Specifications for direct attach cabling

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FOREWORD

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ISO/IEC TR 11801-9907, 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 website.

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

DTR	Report on voting
JTC1-SC25/2841/DTR	JTC1-SC25/2863/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.

A bilingual version of this document may be issued at a later date.

INTRODUCTION

This document provides definitions and examples of direct attach cabling. It provides performance specifications for Classes D, E, E_A, F, F_A, I and II direct attach cabling that can also be used to verify terminating connectors. Performance verification for direct attach cabling will be specified in the second edition of ISO/IEC 14763-4.

INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES –

Part 9907: Specifications for direct attach cabling

1 Scope

This part of ISO/IEC 11801, which is a Technical Report, provides definitions for, and examples of, direct attach cabling configurations.

This document provides performance specifications for Classes D, E, E_A, F, F_A, I and II direct attach cabling by reference to ISO/IEC 11801-1.

Informative limits for Class I direct attach cabling to support 5 m short reach mode application according to ISO/IEC/IEEE 8802-3:2017/AMD3, i.e. 25GBASE-T and 40GBASE-T, are provided in Annex A.

Test methods will be provided in the second edition of ISO/IEC 14763-4.

NOTE ISO/IEC 14763-4 is the test method for End to End (E2E) link. It can be also used for direct attach cabling. Test methods for Classes E_A, F, F_A, I, II will be provided in the second edition of ISO/IEC 14763-4.

Direct attach cabling connects two pieces of equipment, it has connectors at each end, and no intermediate connecting hardware.

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

3 Terms, definitions, abbreviated terms 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 http://www.iso.org/obp

3.1.1
direct attach cabling
cable with free connectors at each end, and with no intermediate connecting hardware, that connects two pieces of equipment

3.2 Abbreviated terms

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

3.3 Symbols

For the purposes of this document, the symbols given in ISO/IEC 11801-1 apply.

4 Specifications

The specifications for direct attach cabling assume the following.

a) The configurations and structure meet the specifications outlined in Clause 5.

b) The interfaces to the cabling meet the specifications of ISO/IEC 11801-1 with respect to mating interfaces and performance.

c) Installation is performed in accordance with ISO/IEC 14763-2.

d) The direct attach cabling meets the specifications of Clause 6.

e) Performance testing to the specifications of Clause 6 is used to provide assurance of installed cabling to determine its capacity to support the applications described by ISO/IEC 11801-1.

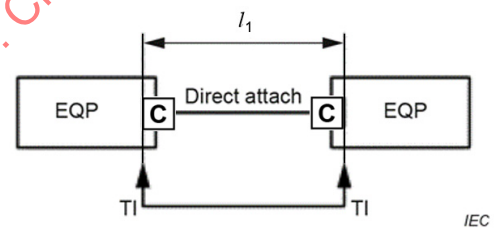
f) The performance of direct attach cabling as specified in Clause 6 supports the link specifications specified in ISO/IEC 11801-1. Performance can be achieved by one of the following when the additional connections are included in the test results:

   1) a direct attach cabling design and implementation ensuring that the prescribed transmission performance is met;

   2) using compatible cabling components that meet the specifications of ISO/IEC 11801-1.

5 Direct attach cabling configuration

See Figure 1.



Key

l_1	length of direct attach cabling
TI	test interface
EQP	equipment
C	connection

Figure 1 – Direct attach cabling

6 Performance specifications

6.1 General

Direct attach performance specifications are based on 3-connection permanent link performance requirements as specified in ISO/IEC 11801-1:2017, Clause 7. These specifications are based on the modelling techniques described in ISO/IEC TR 11801-9903 using the balanced cabling components of Categories 5, 6, 6_A, 7, 7_A, 8.1, and 8.2 of ISO/IEC 11801-1:2017 to provide the specification for Classes D, E, E_A, F, F_A, I and II, respectively.

6.2 Return loss limits

Return loss limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.2.

6.3 Insertion loss limits

Insertion loss limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.3, 3-connection link limits.

6.4 NEXT limits

NEXT limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.4.1, 3-connection link limits.

6.5 PS NEXT limits

PS NEXT limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.4.2, 3-connection link limits.

6.6 ACR-N limits

ACR-N limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.5.2, 3-connection link limits.

6.7 PS ACR-N limits

PS ACR-N limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.5.3, 3-connection link limits.

6.8 ACR-F limits

ACR-F limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.6.2, 3-connection link limits.

6.9 PS ACR-F limits

PS ACR-F limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.6.3, 3-connection link limits.

6.10 TCL limits

TCL limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.11.2.

6.11 ELTCTL limits

ELTCTL limits for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.11.3.

6.12 Coupling attenuation

Coupling attenuation for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.11.4.

6.13 Alien crosstalk

Alien crosstalk for Classes E_A, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.12.

6.14 Direct current loop resistance

Direct current loop resistance for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.7.

6.15 Direct current resistance unbalance within a pair

Direct current resistance unbalance within a pair for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.8.

6.16 Propagation delay

Propagation delay for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.9.

6.17 Delay skew

Delay skew for Classes D, E, E_A, F, F_A, I and II direct attach cabling meet the requirements of ISO/IEC 11801-1:2017, 7.2.10.

7 Direct attach cabling performance

7.1 General

Performance testing can be undertaken either:

a) in a laboratory, where direct attach cabling contains cabling components in a specific design configuration; or

b) in the field, after installation.

7.2 Reference performance testing

This testing is performed on a sample of installed cabling in a laboratory where an assessment against the recommendations of this document is required. The assessment documentation should include details of the number of channels or cabling tested, test evaluation criteria, supplier's declarations and certification, laboratory accreditation and calibration certification.

This testing can also be used for the comparison of measurements performed with laboratory and field test instruments:

a) assessing cabling models in a laboratory environment;

b) assessing parameters that cannot be tested in an installation.

7.3 Installation performance testing

This testing is performed in accordance with Clause 8, on a complete installation of cabling in the field where an assessment against the recommendations of this document is required.

7.4 Installation performance testing of direct attach cabling

Testing to determine performance with the specifications of Clause 5 is optional. Testing should be performed in the following cases:

a) direct attach cabling using components whose transmission performance is lower than that required in ISO/IEC 11801-1;

b) evaluation of cabling to determine its capacity to support a certain group of applications;

c) confirmation of performance of cabling designed in accordance with the reference.

Table 1 contains the test regime for reference performance and installation performance.

Table 1 – Test regime for reference performance and installation performance – Direct attach cabling of Classes D, E, E_A, F, F_A, I, II

Transmission parameter [a]	Reference conformance testing	Installation conformance testing
Return loss	N	N
Insertion loss	N	N
Pair-to-pair NEXT	N	N
PS NEXT	C	C
Pair-to-pair ACR-N	C	C
PS ACR-N	C	C
Pair-to-pair ACR-F	N	N
PS ACR-F	C	C
Direct current (DC) loop resistance	N	N
Direct current (DC) resistance unbalance within a pair	N	O
Direct current (DC) resistance unbalance between pairs	N	O
Propagation delay	N	N
Delay skew	N	N
Unbalance attenuation, near-end (TCL)	N	O
Unbalance attenuation, far-end (ELTCTL)	N	O
Coupling attenuation	N	O
PS ANEXT	N	N_S
PS $ANEXT_{avg}$	C	C
PS AACR-F	N	N_S
PS $AACR\text{-}F_{avg}$	C	C
Wire-map	N	N
Continuity: • signal conductors; • screen conductors (if present); • short circuits; • open circuits.	N	N
Length [b]	I	I

C is calculated with pass/fail criteria.

I is informative testing without pass/fail criteria, if not met by design.

N is normative (100 %) testing with pass/fail criteria, if not met by design.

N_S is normative (sampled) testing, if not met by design. The sample size to be tested should be in accordance with ISO/IEC 14763-2.

O is optional testing with pass/fail criteria, if not met by design.

NOTE The term “met by design” refers to a requirement which may be met by the selection of appropriate materials and installation techniques.

[a] Only those parameters specified for each Class of cabling need to be tested, as required in Clause 6 and Clause 7.

[b] Length is not a pass/fail criterion.

8 Testing of direct attach cabling

Testing of direct attach cabling will be specified in the second edition of ISO/IEC 14763-4.

Annex A
(informative)

Short reach Class I direct attach channel transmission performance

A.1 General

Annex A provides transmission performance specifications for Class I direct attach cabling with a maximum length of 5 m to support 25GBASE-T and 40GBASE-T short reach mode application described in ISO/IEC/IEEE 8802-3:2017/AMD3, Clause 113.

DC loop resistance is not specified for short reach Class I direct attach cabling. DC resistance unbalance is not specified for short reach Class I direct attach cabling.

A.2 Short reach Class I direct attach cabling return loss

Return loss for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.1 for all specified frequencies.

Table A.1 – Short reach Class I direct attach cabling return loss

Class	Frequency MHz	Minimum return loss dB
I	$1 \le f < 25$	$24 + 3\log(f/25)$
	$25 \le f < 1000$	$8 - 10\log(f/1\,000)$
	$1000 \le f < 1600$	8
	$1\,600 \le f \le 2\,000$	$8 - 19\log(f/1\,600)$

A.3 Short reach Class I direct attach cabling insertion loss

Insertion loss for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.2 for all specified frequencies.

Table A.2 – Short reach Class I direct attach cabling insertion loss

Class	Frequency MHz	Minimum insertion loss dB
I	$1 \le f \le 500$	$0{,}05(1{,}5)\left(1{,}8\sqrt{f} + 0{,}005f + 0{,}25/\sqrt{f}\right) + 2\left(0{,}02\sqrt{f}\right) + 0{,}0324\sqrt{f}$
I	$500 < f \le 2\,000$	$0{,}05(1{,}5)\left(1{,}8\sqrt{f} + 0{,}005f + 0{,}25/\sqrt{f}\right) + 2\left(0{,}00649\sqrt{f} + 0{,}000605f\right) + 0{,}0324\sqrt{f}$
NOTE Calculated values less than 3 dB revert to 3 dB.		

A.4 Short reach Class I direct attach cabling NEXT

NEXT for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.3 for all specified frequencies.

Table A.3 – Short reach Class I direct attach cabling NEXT

Class	Frequency MHz	Minimum NEXT dB
I	$1 \le f < 250$	$82,9 - 18,5\log(f)$
	$250 \le f < 383$	$93 - 22,72\log(f)$
	$383 \le f < 500$	$109 - 28,92\log(f)$
	$500 < f \le 2\,000$	$133,5 - 38\log(f)$
NOTE Calculated values greater than 65 dB revert to 65 dB.		

A.5 Short reach Class I direct attach cabling PS NEXT

PS NEXT for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.4 for all specified frequencies.

Table A.4 – Short reach Class I direct attach cabling PS NEXT

Class	Frequency MHz	Minimum PS NEXT dB
I	$1 \le f < 250$	$79,4 - 18,5\log(f)$
	$250 \le f < 331$	$90,65 - 23,2\log(f)$
	$331 \le f < 500$	$105,26 - 29\log(f)$
	$500 < f \le 2\,000$	$129,5 - 38\log(f)$
NOTE Calculated values greater than 62 dB revert to 62 dB.		

A.6 Short reach Class I direct attach cabling ACR-F

ACR-F for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.5 for all specified frequencies.

Due to measurement considerations, for frequencies greater than 200 MHz, Class I short reach direct attach cabling ACRF values that correspond to measured short reach direct attach cabling FEXT loss values of greater than 75 dB are for information only.

Table A.5 – Short reach Class I direct attach cabling ACR-F

Class	Frequency MHz	Minimum ACR-F dB
I	$1 \le f < 2000$	$-20\log\left(10^{\frac{\left(10\log\left(\frac{24}{5}\right)+40-20\log\left(\frac{f}{100}\right)\right)}{-20}} + 2\times 10^{\frac{\left(48,1-20\log\left(\frac{f}{100}\right)\right)}{-20}}\right)$
NOTE Calculated values greater than 65 dB revert to 65 dB. The term 24/5 is derived based on scaling a 24 m reference length to 5 m.		

A.7 Short reach Class I direct attach cabling PS ACR-F

PS ACR-F for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.6 for all specified frequencies.

Table A.6 – Short reach Class I direct attach cabling PS ACR-F

Class	Frequency MHz	Minimum PS ACR-F dB
I	$1 \leq f < 2000$	$-20\log\left(10^{\frac{\left(10\log\left(\frac{24}{5}\right)+37-20\log\left(\frac{f}{100}\right)\right)}{-20}}+2\times10^{\frac{\left(45{,}1-20\log\left(\frac{f}{100}\right)\right)}{-20}}\right)$
NOTE Calculated values greater than 62 dB revert to 62 dB. The term 24/5 is derived based on scaling a 24 m reference length to 5 m.		

A.8 Short reach Class I direct attach cabling propagation delay

Short reach Class I direct attach cabling propagation delay should meet or be less than the values determined using the formulas shown in Table A.7 for all specified frequencies. For field testing, it is sufficient to test at 10 MHz only and short reach Class I direct attach cabling propagation delay at 10 MHz should not exceed 32 ns.

Table A.7 – Short reach Class I direct attach cabling propagation delay

Class	Frequency MHz	Minimum propagation delay ns
I	$1 \leq f < 2000$	$\left(\frac{5}{24}\right)\left(128+\left(\frac{8{,}8}{\sqrt{f}}\right)\right)+(2\times2{,}5)$

A.9 Short reach Class I direct attach cabling delay skew

Short reach Class I direct attach cabling propagation delay skew should be less than 4,8 ns for all frequencies from 1 MHz to 2 000 MHz. The delay skew of any given short reach Class I direct attach cabling should not vary by more than ±0,5 ns from this value due to environmental effects such as the daily temperature variation.

For field testing short reach Class I direct attach cabling, it is sufficient to test at 10 MHz only and short reach Class I direct attach cabling propagation delay skew at 10 MHz should not exceed 4,8 ns.

The value 4,8 is calculated as follows: 13,5 × 5/30 + (2 × 1,25) = 4,8.

A.10 Short reach Class I direct attach cabling PS ANEXT

PS ANEXT for short reach Class I direct attach cabling should meet or exceed the values determined using the formulas shown in Table A.8 for all specified frequencies.