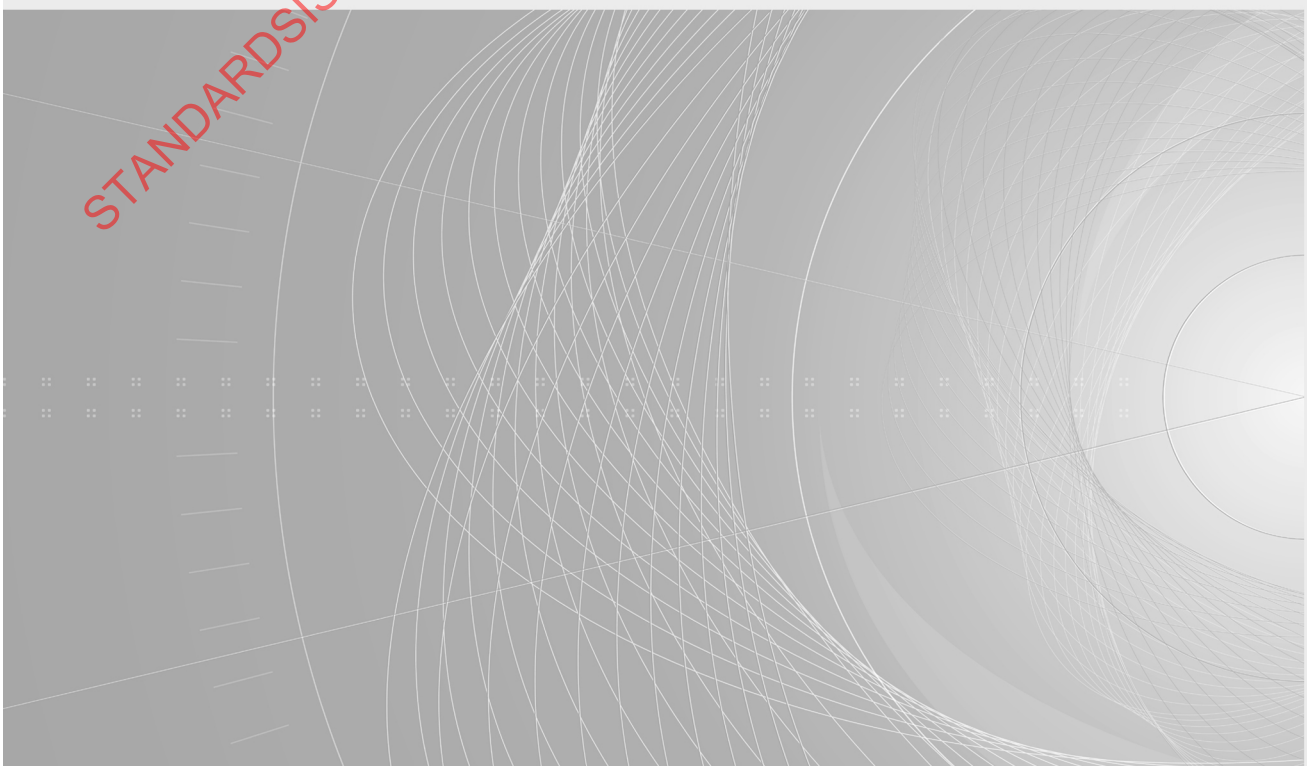
ISO/IEC 14763-4

Edition 2.0 2021-03

INTERNATIONAL STANDARD

Information technology – Implementation and operation of customer premises cabling –
Part 4: Measurement of end-to-end (E2E) links, modular plug terminated links (MPTLs) and direct attach cabling



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INFORMATION TECHNOLOGY – IMPLEMENTATION AND OPERATION OF CUSTOMER PREMISES CABLING –

Part 4: Measurement of end-to-end (E2E) links, modular plug terminated links (MPTLs) and direct attach cabling

FOREWORD

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International Standard ISO/IEC 14763-4 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

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

- measurement of the transmission performance of modular plug terminated link (MPTL) and direct attach cabling were added.
- Additional requirements of test head designs of E2E link were introduced.

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

FDIS	Report on voting
JTC1-SC25/2997/FDIS	JTC1-SC25/3010/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.

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

A list of all parts of the ISO/IEC 14763 series, published under the general title *Information technology – Implementation and operation of customer premises cabling*, can be found on the IEC and ISO websites.

INTRODUCTION

The testing of balanced cabling channels in accordance with ISO/IEC 11801-1 does not verify the performance of the free connector at each end of the channel.

This document describes the measurement of three cabling structures which verifies the performance of their terminating connectors. These are:

a) end-to-end (E2E) link of ISO/IEC 11801-3,

b) modular plug terminated link (MPTL) of ISO/IEC TR 11801-9910,

c) direct attach cabling of ISO/IEC TR 11801-9907.

This measurement includes the transmission performance of the connector components which terminate the cabling under test.

INFORMATION TECHNOLOGY – IMPLEMENTATION AND OPERATION OF CUSTOMER PREMISES CABLING –

Part 4: Measurement of end-to-end (E2E) links, modular plug terminated links (MPTLs) and direct attach cabling

1 Scope

This part of ISO/IEC 14763 specifies the measurement of two- and four-pair balanced cabling of

a) end-to-end (E2E) link Class D, E and E_A;

b) modular plug terminated links (MPTLs) of Class D, E, E_A, F, F_A and of Class I and II;

c) direct attach cabling of Class D, E, E_A, F, F_A and of Class I and II.

The free connectors which terminate two and four pairs in field and laboratory conditions are included.

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 60512-27-100, *Connectors for electronic equipment – Tests and measurements – Part 27-100: Signal integrity tests up to 500 MHz on 60603-7 series connectors – Tests 27a to 27g*

IEC 61935-1:2019, *Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards*

IEC 61935-2, *Specification for the testing of balanced and coaxial information technology cabling – Part 2: Cords as specified in ISO/IEC 11801 and related standards*

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

ISO/IEC 11801-3, *Information technology – Generic cabling for customer premises – Part 3: Industrial premises*

ISO/IEC TR 11801-9907, *Information technology – Generic cabling systems – Part 9907: Specifications for direct attach cabling*

ISO/IEC TR 11801-9910, *Information technology – Generic cabling systems – Part 9910: Specifications for modular plug terminated link cabling*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11801-1, ISO/IEC 11801-3, ISO/IEC TR 11801-9907 and ISO/IEC TR 11801-9910 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

3.2 Abbreviated terms

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

E2E	end-to-end
L	length of E2E link, MPTL and direct attach cabling
MPTL	modular plug terminated link(s)
TEST EQP	test equipment

4 Conformance

For a measurement of E2E link, MPTL or direct attach cabling to conform to this document, the following applies:

a) The requirements of the applicable cabling design standards shall be applied.

b) The performance of E2E link, MPTL and direct attach cabling shall conform to Clause 5.

c) The testing shall be undertaken in accordance with Clause 8.

d) The test head shall meet the requirements of Clause 9.

5 Transmission performance of E2E links, MPTLs and direct attach cabling

Table 1 indicates the references to performance limits applicable to the measurements.

Table 1 – Transmission performance limits

Cabling configuration	Reference for performance limits
E2E link	ISO/IEC 11801-3 [a,b]
MPTL	ISO/IEC TR 11801-9910
direct attach cabling	ISO/IEC TR 11801-9907
[a] For more details, see ISO/IEC 11801-3.	
[b] The relevant requirements were added by ISO/IEC 11801-3:2017/AMD1	

6 Transmission limits of E2E link, MPTLs and direct attach cabling

The cabling under test shall comply with the transmission limits for the designated category in Table 1 when tested with the corresponding test head as described in Clause 9 and the transmission limits of all lower categories.

E2E link testing should be used to provide assurance of installed cabling terminated at both ends in accordance with the IEC 60603-7 series, IEC 61076-3-106, IEC 61076-3-117, IEC 61076-2-101, IEC 61076-2, IEC 61076-3-104, IEC 61076-3-109 or IEC 61076-3-110.

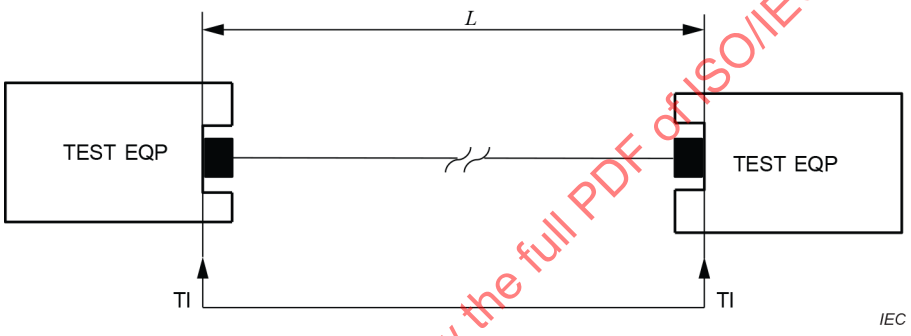
MPTL testing should be used to provide assurance of installed cabling terminated at both ends in accordance with ISO/IEC TR 11801-9910.

Direct attach cabling testing should be used to provide assurance of installed cabling terminated at both ends in accordance with the IEC 60603-7 series, IEC 61076-2-101, IEC 61076-3-104, IEC 61076-2-109 and IEC 61076-3-110.

7 Reference planes of E2E link, MPTL and direct attach cabling

7.1 Reference planes of E2E link

The reference planes for the measurement of E2E links are shown in Figure 1.



Key

L Length of E2E cabling

TI Test interface

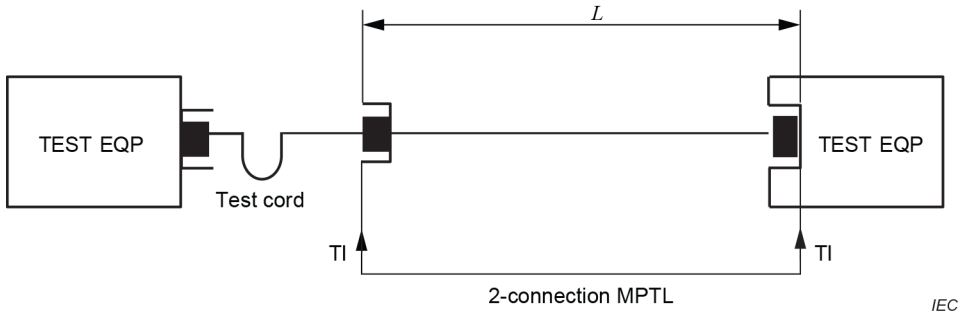
EQP Equipment

Plug & jack

Figure 1 – Reference planes of E2E links

7.2 Reference planes of MPTL

The reference planes for the measurement of MPTL configurations are shown in Figure 2 and Figure 3.



Key

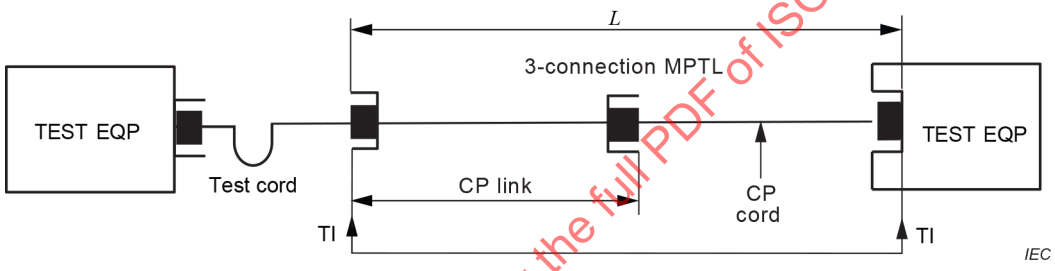
L Length of MPTL cabling

TI Test interface

EQP Equipment

Plug & jack

Figure 2 – Reference planes of 2-connection MPTL



Key

L Length of MPTL cabling

TI Test interface

EQP Equipment

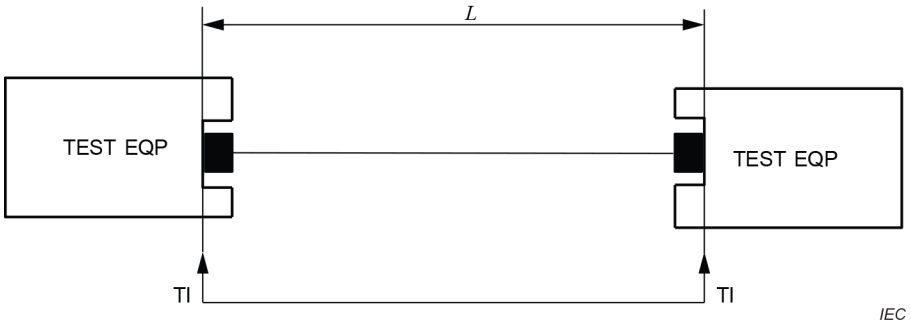
C Connection

Plug & jack

Figure 3 – Reference planes of 3-connection MPTL

7.3 Reference planes of direct attach cabling

The reference planes for the measurement of direct attach cabling are shown in Figure 4.



Key

L Length of direct attach cabling

TI Test interface

EQP Equipment

Plug & jack

Figure 4 – Reference planes of direct attach cabling

8 Testing

8.1 General

Performance testing can be undertaken either in a laboratory or in the field after installation.

The test regime of reference performance and installation performance of E2E link, MPTL and direct attach cabling shall be in accordance with Annex B.

This testing is independent from any requirements for acceptance testing contained within an installation specification, such as for balanced cabling in ISO/IEC 14763-2.

Conformity with E2E link, MPTL and direct attach cabling requirements can be assured using any corresponding test head conforming to this document.

8.2 Laboratory testing of E2E link, MPTL and direct attach cabling

The test configuration shall be carried out in accordance with IEC 61935-2 for 100 Ω cabling. The test head shall conform to Clause 9.

The test regime for laboratory testing is listed in Table B.2 as reference conformance testing and shall be carried out and calculated in accordance with the reference laboratory measurement procedures on cabling topologies of IEC 61935-1.

8.3 Field testing of E2E link, MPTL and direct attach cabling

8.3.1 Basic criteria

Before making any measurement, the following inspection shall be undertaken:

a) visual inspection in accordance with the applicable installation specification, for two-pair and four-pair balanced cabling.

b) connectivity testing in accordance with the applicable installation specification.

8.3.2 Requirements of field test equipment

The specific performance level for field test equipment used to test E2E link, MPTL and direct attach cabling shall be provided by IEC 61935-1 tester requirements in accordance with Table 2.

Table 2 – Overview level for field test equipment of performance of E2E link, direct attach cabling and MPTLs

Class of E2E link, direct attach cabling and MPTLs	IEC 61935-1 tester level
D	IIe
E	III
E_A	IIIe
F	IV
F_A	V
I	VI
II	VI

Cable assemblies constructed in the field can be tested for performance by field test equipment. The specific performance level for field test equipment used to test E2E link, direct attach cabling and MPTL shall be in accordance with IEC 61935-1:2019, 5.1.

8.3.3 Field test measurement parameters

The test regime for installation testing is given in Table B.2 as installation conformance testing and shall be carried out and calculated in accordance with installation measurement procedures on cabling topologies of IEC 61935-1.

9 Test head requirements

9.1 General

The measured results of E2E link, direct attach cabling and MPTLs are dependent on the required performance of the test heads used in the test setup.

The test heads specified in this document shall meet the requirements of IEC 61935-2 and the test head shall be centred within the range of test plugs required for the category of test.

In addition to the above requirements, test heads to be used for measurement of E2E links shall be assessed against the following requirements in order to further minimize test variation when compared to patch cord testing.

9.2 Additional test head requirements in accordance with the IEC 60603-7 series

When evaluating an E2E link test head, the procedure specified in IEC 60512-27-100 shall be followed to confirm that the test head is compliant as mated connecting hardware. This process generates data for the de-embedded NEXT performance of the jack (fixed connector), which is in turn re-embedded with mathematical test plugs to establish compliance as mated connection, and further processed in accordance with IEC 61935-2 to establish the centring requirements for patch cord test head compliance.

For conformity with this document, the de-embedded performance of the jack shall also be assessed against the requirements for Category 5, 6, 6_A, 7, 7_A, 8.1 and 8.2 of ISO/IEC 11801-1 and of IEC 61935-2.

The application of such a small amount of permitted NEXT variation effectively controls variation on other crosstalk parameters.

The requirements for a test head of Category 6_A, 7, 7_A, 8.1 and 8.2 shall conform to the corresponding Category specifications in IEC 61935-2.

NOTE For Category 8.1 the test heads are specified to comply with IEC 60603-7-81 jack requirements.

If other form factors or different pairs are used, then the performance of the test heads of the IEC 60603-7 jacks shall be used.

9.3 Test head requirements of IEC 61076-2-101

The test heads shall meet the following minimum requirements:

a) NEXT = 87 − 20 log(f); max. 80 dB
b) FEXT = 75,1 − 20 log(f), max. 80 dB
c) RL = 60 − 20 log(f), max. 30 dB

9.4 Test head requirements of IEC 61076-2-109

The test heads shall meet the following minimum requirements:

a) NEXT = 94 − 20 log(f)
b) FEXT = 83,1 − 20 log(f)
c) RL = 68 − 20 log(f)

Annex A
(informative)

Example performance of E2E link test heads

A.1 Example Category 5 test head performance

The performance of test heads using Category 5 components is given in 9.1 and 9.2.

An example of the de-embedded fixed connector NEXT performance of the Category 5 test head is given in with Table A.1.

Table A.1 – Example performance of free connector de-embedded NEXT for Category 5 E2E test heads in the frequency range 50 MHz ≤ f < 100 MHz

Pair combination	Frequency MHz	Example low de-embedded jack NEXT dB	Example high de-embedded jack NEXT dB
1,2 – 3,6	$50 \le f < 100$	$87,5 - 20\log(f)$	$89,5 - 20\log(f)$
1,2 – 4,5	$50 \le f < 100$	$93,5 - 20\log(f)$	Not applicable
1,2 – 7,8	$50 \le f < 100$	$93,5 - 20\log(f)$	Not applicable
3,6 – 4,5	$50 \le f < 100$	$75,5 - 20\log(f)$	$77,5 - 20\log(f)$
3,6 – 7,8	$50 \le f < 100$	$87,5 - 20\log(f)$	$89,5 - 20\log(f)$
4,5 – 7,8	$50 \le f < 100$	$93,5 - 20\log(f)$	Not applicable

A.2 Example Category 6 test head performance

The performance of test heads using Category 6 components is given in 9.1 and 9.2.

An example of the de-embedded fixed connector NEXT performance of the Category 6 test head is given in Table A.2.

Table A.2 – Example performance of free connector de-embedded NEXT for Category 6 E2E test heads in the frequency range 50 MHz ≤ f < 250 MHz

Pair combination	Frequency MHz	Example low de-embedded jack NEXT dB	Example high de-embedded jack NEXT dB
1,2 – 3,6	$50 \le f < 250$	$87,10 - 20\log(f) + \begin{pmatrix} -1,60\times10^{-8}\times f^3 + 1,10\times10^{-5}\times f^2 \\ -3,0\times10^{-3}\times f + 0,213 \end{pmatrix}$	$88,40 - 20\log(f) + \begin{pmatrix} -1,60\times10^{-8}\times f^3 + 1,10\times10^{-5}\times f^2 \\ -3,0\times10^{-3}\times f + 0,213 \end{pmatrix}$
1,2 – 4,5	$50 \le f < 250$	$98,0 - 20\log(f)$	Not applicable
1,2 – 7,8	$50 \le f < 250$	$103,0 - 20\log(f)$	Not applicable
3,6 – 4,5	$50 \le f < 250$	$79,29 - 20\log(f) + \begin{pmatrix} -3,65\times10^{-8}\times f^3 + 3,9\times10^{-5}\times f^2 \\ -2,7\times10^{-3}\times f - 3,64\times10^{-2} \end{pmatrix}$	$79,61 - 20\log(f) + \begin{pmatrix} -3,65\times10^{-8}\times f^3 + 3,9\times10^{-5}\times f^2 \\ -2,7\times10^{-3}\times f - 3,64\times10^{-2} \end{pmatrix}$
3,6 – 7,8	$50 \le f < 250$	$87,90 - 20\log(f) + \begin{pmatrix} -5,00\times10^{-8}\times f^3 + 4,10\times10^{-5}\times f^2 \\ +1,0\times10^{-3}\times f - 4,29\times10^{-2} \end{pmatrix}$	$89,30 - 20\log(f) + \begin{pmatrix} -5,00\times10^{-8}\times f^3 + 4,10\times10^{-5}\times f^2 \\ +1,0\times10^{-3}\times f - 4,29\times10^{-2} \end{pmatrix}$
4,5 – 7,8	$50 \le f < 250$	$98,0 - 20\log(f)$	Not applicable