ISO/IEC TR 11801-9903

Edition 1.0 2015-10

TECHNICAL REPORT

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Information technology – Generic cabling systems for customer premises – Part 9903: Matrix modelling of channels and links

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INFORMATION TECHNOLOGY – GENERIC CABLING SYSTEMS FOR CUSTOMER PREMISES –

Part 9903: Matrix modelling of channels and links

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ISO/IEC TR 11801-9903, which is a technical report, has been 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 web site.

This Technical Report has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

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

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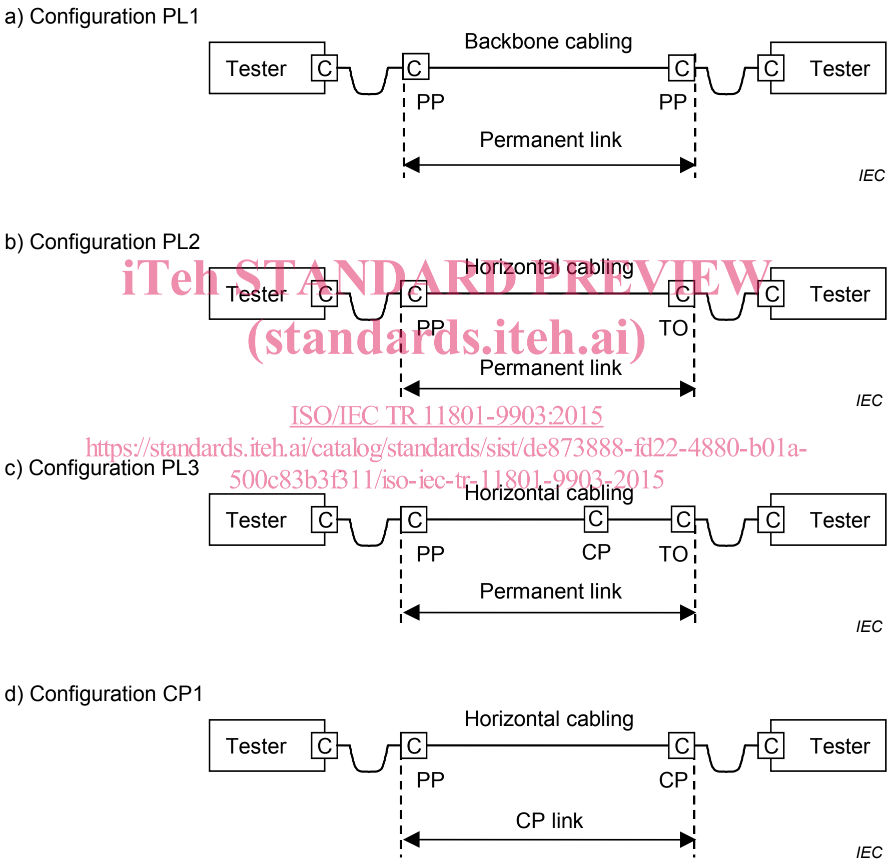
INTRODUCTION

The pass/fail limits for defined channel and permanent link cabling configurations have an implicit impact on the component limits for the cabling components used. The channel configurations are described in Clause 5, the link configurations in Clause 6 of ISO/IEC 11801:2002 with its amendments 1:2008 and 2:2010.

The permanent link configurations, which represent the fixed portion of the cabling, have two possible topologies:

A connection plus a segment of cable plus a connection (2 connector topology).

A connection plus a segment of cable plus a connection plus another segment of cable plus another connection (3 connector topology).



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PP = patch panel; C = connection; CP = consolidation point;

TO = telecommunications outlet

Figure 1 – Link configurations of ISO/IEC 11801:2002

This Technical Report includes models and assumptions, which support pass/fail limits for the channel and permanent link test configurations in this standard. These are based on the performance requirements of cable and connecting hardware as specified in IEC standards.

This Technical Report provides reasonable assurance that a channel created by adding compliant patch cords to a previously certified permanent link will meet the applicable channel performance limits.

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Over the years the frequencies of the classes increased, but the theory for calculating the limits stayed the same. Especially the higher order effects had to be considered and at the end only by doing a Monte Carlo calculation, assuming that not all components would be at the limit at the same time, allowed to prove compliance.

The model uses 2 pairs for all calculations. The limits are equal for pairs or pair combinations but in reality measured values could be different. If results are required that need more pairs to be considered, then this calculation can be done based on the results from multiple 2 pair calculations with appropriate inputs (worst case). An example of such a calculation is the power sum and average limit lines for 4 pairs.

Symmetry and additional contributions that result from unbalanced signals and differential-to-common and common-to-differential mode coupling are not included in this Technical Report but can be added easily in a next step by increasing the matrix size.

For details on the naming of transmission parameters, see definitions and Clause C.1.

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INFORMATION TECHNOLOGY –
GENERIC CABLING SYSTEMS FOR CUSTOMER PREMISES –

Part 9903: Matrix modelling of channels and links

1 Scope

This part of ISO/IEC 11801 establishes a matrix-model for formulating limits for differential mode parameters for return loss, insertion loss, and near and far end crosstalk, within and between two pairs of balanced cabling. This is for the purpose of supporting new, improved balanced cabling channel and link specifications, which are expected to be included in the next edition of ISO/IEC 11801[1].

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*
Amendment 1:2008
Amendment 2:2010[2]

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3 Terms, definitions and abbreviations

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3.1 Terms and definitions

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

3.1.1
attenuation
general term to indicate diminishing of signal strength

Note 1 to entry: Details need to be added to indicate the exact usage.

3.1.2
connection
two mated connectors

EXAMPLE: Jack and plug.

3.1.3
image attenuation
wave attenuation
attenuation when a two-port is terminated by its input and output characteristic impedances with no reflections at input and output

Note 1 to entry: The wave attenuation of cables is length scalable.

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1 A new edition of ISO/IEC 11801 is under consideration and is planned as ISO/IEC 11801-1 (first edition).

2 A consolidated version of this publication exists, comprising ISO/IEC 11801:2002, ISO/IEC 11801:2002/AMD 1:2008 and ISO/IEC 11801:2002/AMD 2:2010.

3.1.4
insertion loss
attenuation or loss caused by a two-port inserted into a system

3.1.5
insertion loss deviation
deviation of loss (attenuation) with regard to the wave attenuation due to mismatches (not only at the ends)

3.1.6
operational attenuation
ratio of the square root of the maximum available (complex) power wave from the generator and the square root of the (complex) power consumed (taken) by the load of the two-port

Note 1 to entry: The operational attenuation is not length scalable (see also C.3.1 and C.3.2).

Note 2 to entry: The operational attenuation is expressed in decibels (dB) and radians (rad).

3.1.7
passivity
property of a passive electrical system

Note 1 to entry: The output power at all ports that does not exceed the input power at all ports.

3.1.8
unitarity
mathematical concept for matrices to define passivity

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3.1.9
operational reflection of a junction
loss due to the reflection at a junction

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Note 1 to entry: See also C.3.6.

3.2 Abbreviations

For the purposes of this document, the abbreviations given in ISO/IEC 11801 and the following apply.

DRL	distributed return loss
NEXT-L	near end crosstalk loss
NEXT-T	near end crosstalk transfer function
FEXT-L	far end crosstalk loss
FEXT-T	far end crosstalk transfer function
ρ	Reflection transfer function
RI	Return loss
attenuation-L	attenuation loss
attenuation-T	attenuation transfer function

4 Matrix model

The model to be used is a concatenated matrix calculation as discussed in IEC TR 62152 for a 2 port system. For a 2 pair balanced cabling calculation a 4 port differential matrix as shown in Figure 1 shall to be used.

The model assumes that all components are specified with S-parameters and these parameters are used then to fill an S-matrix for every cabling component.

To concatenate components these S-matrices are transformed into transmission T-matrices which can then be multiplied in the appropriate order to simulate the transmission characteristics of the concatenated components (for details see IEC TR 62152:2009, Annex C).

To evaluate the transmission performance of the modelled channel or permanent link the calculated T-matrix of the cabling is transformed back into an S-matrix providing the expected transmission parameters of the cabling system.

The matrix calculation is done mathematically with S-parameters in amplitude and phase:

a) Measured S parameters are usually known in amplitude and phase.
b) Parameter limit lines for components and for cabling are specified in amplitude only, usually in decibel. For modelling purposes these amplitudes shall be transformed into a linear value. For the matrix calculation the phase is added as a random value to reflect power sum addition (see Clause 6).

5 Matrix definition

5.1 Quadriports

In IEC TR 62152 [1] voltage and currents of the input and output waves are specified for two ports. In the following the cabling specific notation needed for quadriports (2 pairs) is detailed.

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5.2 Matrix port definition for a two pair system representative for modelling purposes

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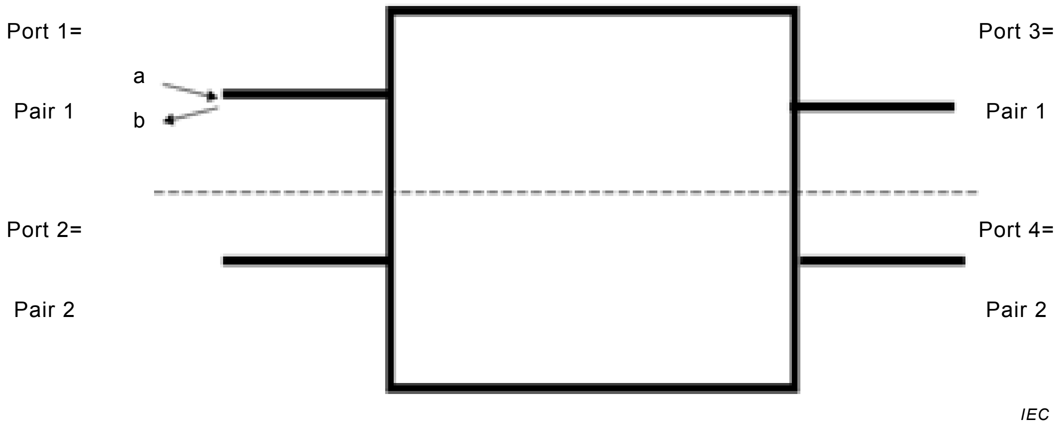
In Figure 2 a 4 port matrix is presented. The definition is one line per port/twisted pair.



Key

a designates a wave entering the quadriport

b designates a wave leaving the quadriport

Figure 2 – Matrix definition of a 4 port 2 twisted pair system

5.3 Operational scattering matrix

Here, the S parameters for a source at port 2 are shown. For all definitions, see 5.4.