

# ISO/IEC TS 11801-9903

Edition 2.0 2025-09

# TECHNICAL SPECIFICATION

Information technology - Generic cabling for customer premises - Part 9903: Modelling of channels and links

(https://standards.iteh.ai)
Document Preview

ISO/IEC TS 11801-9903·2025

https://standards.iteh.ai/catalog/standards/iec/3000c1b2-7300-400b-a26d-ca810679ceb3/iso-iec-ts-11801-9903-202

SO/IEC TS 11801-9903: 2025-09(en)



# THIS PUBLICATION IS COPYRIGHT PROTECTED Copyright © 2025 ISO/IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat Tel.: +41 22 919 02 11

3, rue de Varembé info@iec.ch CH-1211 Geneva 20 www.iec.ch

Switzerland

#### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

#### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

### IEC publications search -

#### webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - webstore.iec.ch/justpublished**Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

### IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

## Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**Preview** 

ISO/IEC TS 11801-9903:2025

1ttps://standards.item.ai/catalog/standards/iec/3000c102-7300-4000-a20d-ca810079ce03/is0-iec-ts-11801-9903-202

# CONTENTS

TOREWORL	J	
INTRODUCT	TION	6
1 Scope		7
•		
•		
4.1 G	eneral	9
_		_
4.2.1		
4.2.2		
4.2.3	Matrix port definition for a two-pair system representative for modelling	
	·	
4.2.4		
4.2.5	•	
4.2.6		
4.2.7	Passivity	12
	1 I ON STONGONG	
4.2.9	,	
4.2.10		
4.3 G		
4.3.1	General	14
4.3.2	Mixed-mode S-parameters matrix and submatrices	14
· · · · · · · · · · · · · · · · · · ·		
standarAs2iteh.F	ormulas/standards/iec/3000c1b2-7300-400b-a26d-ca810679ceb3/iso-iec-ts	-1189 <del>17</del> -9903-
A.2.1	S to T-matrix	17
A.2.2	T to S matrix	17
A.2.3	Conversion matrices	17
Annex B (inf	ormative) Transmission model terms and definitions	19
B.1 Co	omparison of namings	19
B.2 G	eneral	20
B.3 Ba	ackground of terms and definitions	20
B.3.1	-	
B.3.2	·	
B.3.3	Image or wave transfer function (T)	22
B.3.4	Insertion transfer function of a two-port (TBI)	22
B.3.5	<del>-</del> ·	
B.3.6	<del>-</del> '	
•		
		24 25
	INTRODUCT  1 Scope. 2 Normat 3 Terms, 3.1 Terms, 3.2 Strict 4 Matrix or 4.1 Gray delay 4.2.1 delay 4.2.2 delay 4.2.3 delay 4.2.4 delay 4.2.5 delay 4.2.10 delay 4.3.1 delay 4.3.	INTRODUCTION  1 Scope 2 Normative references 3 Terms, definitions, symbols and abbreviated terms

C.2.3	Assumptions for insertion loss	25
C.3 NEX	Т	26
C.3.1	NEXT of the channel configuration	26
C.3.2	NEXT of the permanent link configurations	26
C.3.3	Assumptions for NEXT	27
C.4 ACR	-F	30
C.4.1	ACR-F of the channel configuration	30
C.4.2	ACR-F for the permanent link configurations	31
C.4.3	Assumptions for ACR-F	31
C.5 No F	Return loss	31
C.5.1	Return loss of the channel and permanent link configurations	31
C.5.2	Assumptions for the return loss circuit analysis method	32
C.6 PS A	NEXT link modelling	35
C.6.1	General	35
C.6.2	PS ANEXT between connectors	35
C.6.3	PS ANEXT between cable segments	35
C.6.4	Principles of link modelling	36
	AACR-F link modelling	
C.7.1	General	36
C.7.2	PS AFEXT between connectors	36
C.7.3	PS AACR-F between cable segments	36
C.7.4	Principles of link modelling	
C.7.5	Impact of PS AACR-F in channels and links with substantially different lengths	
C.8 Com	ponent assumptions for modelling purposes	40
	mative) Alternative calculation of matrix terms for limit lines	
•	eral	
	acting limit lines	
	15U/IEC 15 110U1-99U5.ZUZ5	
	nulas to extract the cabling limit lines	
	Crosstalk	
	Reflection and return loss (RL)	
	ponent values used as input to the model	
D.4.1	General	
D.4.1 D.4.2	Cable	
	Connections	
	mative) Signal-to-noise ratio modelling	
•	eral	
E.2.1	smission system model	
	General	
	Transmitter pulse	
E.2.3 E.2.4	Receiving criteria	
	The electrical channel	
	Power spectral density (PSD):	
	Noise definition	
	Modulation	
	Bit error ratio (BER)	
E.2.9	Signal-to-noise ratio (SNR)	52 53

E.3.1	General	53
E.3.2	Comparison with other calculations:	53
Bibliography.		56
Figure 1 – Ma	atrix definition of a 4-port two twisted pair system	10
Figure 2 – Op	perational scattering parameters example from port 2	11
	ansmission matrix concatenation showing an example of a 2-connector k	13
	Defining the operational attenuation and the operational transfer functions	21
Figure B.2 – I	Defining the reflection transfer functions and the return loss of a junction	23
Figure C.1 –	Example of computation of NEXT with higher precision	27
Figure C.2 –	Example of increased impact of PS AFEXT	37
	Graphical example of a NEXT calculation showing statistical results (red	43
Figure D.2 –	100 m cable return loss without reflection at both ends	47
	100 m cable return loss with a reflection of 0,03 at both ends h, ~23 dB return loss at 1 MHz)	47
Figure E.1 – I	Different noise spectra	51
	Results using this calculation, which show good agreement with similar n [12]	54
Figure E.3 – I	Presentation on best modulation scheme (PAM4) and signal-to-noise ratio	
Table 1 _ All	four ports operational scattering parameter definition	11
	L/TCTL and LCL/LCTL port designations	
	ual S-parameters for real components	
	errelation of mixed-mode mode-conversion and related parameters	
	ed-mode S-parameter notation	
	comparison of naming in ISO/IEC 11801-1 and ISO/IEC TS 11801-9903	
	nsertion loss deviation	
	Modelling assumptions for cable transmission parameters	
	Model input assumptions used in the statistical calculation (Class $E_A$ )	
	Model input assumptions used in the statistical calculation (Class $F_{A}$ )	
Table E.1 – T	ypical noise limits for 1-pair channels	51
	Comparison of different modulation PAM levels	
	ummary	

# Information technology -Generic cabling for customer premises -Part 9903: Modelling of channels and links

## **FOREWORD**

- 1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.
- 2) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO National bodies.
- 3) IEC and ISO documents have the form of recommendations for international use and are accepted by IEC and ISO National bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC and ISO documents is accurate, IEC and ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC and ISO National bodies undertake to apply IEC and ISO documents transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC and ISO document and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC and ISO do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC and ISO marks of conformity. IEC and ISO are not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this document.
- 7) No liability shall attach to IEC and ISO or their directors, employees, servants or agents including individual experts and members of its technical committees and IEC and ISO National bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this ISO/IEC document or any other IEC and ISO documents.
- 8) Attention is drawn to the Normative references cited in this document. Use of the referenced publications is indispensable for the correct application of this document.
- 9) IEC and ISO draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC and ISO take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC and ISO had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch and www.iso.org/patents. IEC and ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 11801-9903 has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology. It is a Technical Specification.

This second edition cancels and replaces the first edition published in 2021. This edition constitutes a technical revision.

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

- a) the expansion of the list of specified parameters to include mixed-mode mode-conversion and related unbalance attenuation parameters;
- b) the addition of an informative annex covering the topic of signal-to-noise ratio and its relation to the S-parameter matrix channel model.

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

Draft	Report on voting
JTC1-SC25/3324/DTS	JTC1-SC25/3333/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.

A list of all parts in the ISO/IEC 11801 series, published under the general title *Information technology - Generic cabling for customer premises*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, and the ISO/IEC Directives, JTC 1 Supplement available at www.iec.ch/members experts/refdocs and www.iso.org/directives.

# iTeh Standards (https://standards.iteh.ai) Document Preview

ISO/IEC TS 11801-9903:2025

https://standards.iteh.ai/catalog/standards/iec/3000c1b2-7300-400b-a26d-ca810679ceb3/iso-iec-ts-11801-9903-202