



# SLOVENSKI STANDARD SIST EN 60512-28-100:2013

01-julij-2013

---

**Konektorji za elektronsko opremo - Preskusi in meritve - 28-100. del: Preskusi signalne celovitosti do 1 000 MHz na konektorjih serij IEC 60603-7 in IEC 61076-3 - Preskusi od 28a do 28g**

Connectors for electronic equipment - Tests and measurements - Part 28-100: Signal integrity tests up to 1 000 MHz on IEC 60603-7 and IEC 61076-3 series connectors - Tests 28a to 28g

**iTeh STANDARD PREVIEW  
(standards.iteh.ai)**

Connecteurs pour équipements électroniques - Essais et mesures - Partie 28-100: Essais d'intégrité du signal jusqu'à 1 000 MHz sur des connecteurs conformes aux séries CEI 60603-7 et CEI 61076-3 - Essais 28a à 28g

**Ta slovenski standard je istoveten z: EN 60512-28-100:2013**

---

**ICS:**

31.220.10      Vtiči in vtičnice, konektorji      Plug-and-socket devices.  
Connectors

**SIST EN 60512-28-100:2013**      en

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60512-28-100:2013](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013)

<https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013>

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 60512-28-100**

April 2013

ICS 31.220.10

English version

**Connectors for electronic equipment -  
Tests and measurements -  
Part 28-100: Signal integrity tests up to 1 000 MHz on IEC 60603-7  
and IEC 61076-3 series connectors - Tests 28a to 28g  
(IEC 60512-28-100:2013)**

Connecteurs pour équipements  
électroniques - Essais et mesures -  
Partie 28-100: Essais d'intégrité  
des signaux jusqu'à 1 000 MHz  
sur les connecteurs des séries  
CEI 60603-7 et CEI 61076-3 -  
Essais 28a à 28g  
(CEI 60512-28-100:2013)

Steckverbinder für elektronische  
Einrichtungen -  
Mess- und Prüfverfahren -  
Teil 28-100: Signalintegritätsprüfungen  
bis 1 000 MHz an Steckverbindern der  
Reihen IEC 60603-7 und IEC 61076-3 -  
Prüfungen 28a bis 28g  
(IEC 60512-28-100:2013)

[SIST EN 60512-28-100:2013](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-311000000000/iec-60512-28-100-2013)

[https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-311000000000/iec-60512-28-100-2013)

This European Standard was approved by CENELEC on 2013-03-13. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Foreword

The text of document 48B/2322/FDIS, future edition 1 of IEC 60512-28-100, prepared by SC 48B "Connectors" of IEC/TC 48 "Electromechanical components and mechanical structures for electronic equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60512-28-100:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-12-13
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-03-13

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

## Endorsement notice

The text of the International Standard IEC 60512-28-100:2013 was approved by CENELEC as a European Standard without any modification.

**(standards.iteh.ai)**

[SIST EN 60512-28-100:2013](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013)

<https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013>

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-581	-	International Electrotechnical Vocabulary (IEV) - Part 581: Electromechanical components for electronic equipment	-	-
IEC 60512-1	-	Connectors for electronic equipment - Tests and measurements - Part 1: General	EN 60512-1	-
IEC 60512-26-100	2008	Connectors for electronic equipment - Tests and measurements - Part 26-100: Measurement setup, test and reference arrangements and measurements for connectors according to IEC 60603-7 Tests 26a to 26g	EN 60512-26-100	2008
IEC 60603-7	Series	Connectors for electronic equipment	EN 60603-7	Series
IEC 61076-1	-	Connectors for electronic equipment - Product requirements - Part 1: Generic specification	EN 61076-1	-
IEC 61076-3-104	-	Connectors for electronic equipment - Product requirements - Part 3-104: Detail specification for 8-way, shielded free and fixed connectors for data transmissions with frequencies up to 1 000 MHz	EN 61076-3-104	-
IEC 61076-3-110	-	Connectors for electronic equipment - Product requirements - Part 3-110: Detail specification for shielded, free and fixed connectors for data transmission with frequencies up to 1 000 MHz	EN 61076-3-110	-
IEC 61156	Series	Multicore and symmetrical pair/quad cables - for digital communications - Part 1-2: Electrical transmission characteristics and test methods of symmetrical pair/quad cables	-	-
IEC 61156-6	-	Multicore and symmetrical pair/quad cables - for digital communications - Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz - Work area wiring - Sectional specification	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61169-16	-	Radio-frequency connectors - Part 16: RF coaxial connectors with inner diameter of outer conductor 7 mm (0,276 in) with screw coupling - Characteristic impedance 50 ohms (75 ohms) (Type N)	EN 61169-16	-
IEC 62153-4-12	-	Metallic communication cable test methods - - Part 4-12: Electromagnetic compatibility (EMC) - Coupling attenuation or screening attenuation of connecting hardware - Absorbing clamp method		-
ISO/IEC 11801	-	Information technology - Generic cabling for - customer premises		-

## **iTeh STANDARD PREVIEW** **(standards.iteh.ai)**

[SIST EN 60512-28-100:2013](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013)

<https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013>



IEC 60512-28-100

Edition 1.0 2013-02

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Connectors for electronic equipment – Tests and measurements –  
Part 28-100: Signal integrity tests up to 1 000 MHz on IEC 60603-7 and  
IEC 61076-3 series connectors – Tests 28a to 28g**

**Connecteurs pour équipements électroniques – Essais et mesures –  
Partie 28-100: Essais d'intégrité des signaux jusqu'à 1 000 MHz sur les  
connecteurs des séries CEI 60603-7 et CEI 61076-3 – Essais 28a à 28g**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX



ICS 31.220.10

ISBN 978-2-83220-639-3

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	5
1 Scope.....	7
2 Normative references .....	7
3 Terms, definitions and acronyms .....	8
3.1 Terms and definitions .....	8
3.2 Acronyms .....	8
4 Overall test arrangement .....	9
4.1 Test instrumentation.....	9
4.2 Measurement precautions .....	9
4.3 Mixed mode S-parameter nomenclature .....	10
4.4 Coaxial cables and interconnect for network analysers.....	11
4.5 Requirements for switching matrices .....	11
4.6 Test fixture requirements.....	12
4.7 Requirements for termination performance at calibration plane.....	13
4.8 Reference loads for calibration .....	13
4.9 Calibration.....	14
4.10 Termination loads for termination of conductor pairs .....	14
4.10.1 General.....	14
4.10.2 Verification of termination loads.....	15
4.11 Termination of screens.....	15
4.12 Test specimen and reference planes .....	15
4.12.1 General .....	15
4.12.2 Interconnections between device under test (DUT) and the calibration plane.....	16
4.13 Overall test setup requirements.....	18
5 Connector measurement up to 1 000 MHz .....	18
5.1 General .....	18
5.2 Insertion loss, Test 28a .....	19
5.2.1 Object.....	19
5.2.2 Connecting hardware insertion loss .....	19
5.2.3 Test method .....	19
5.2.4 Test set-up .....	19
5.2.5 Procedure.....	19
5.2.6 Test report.....	20
5.2.7 Accuracy .....	20
5.3 Return loss, Test 28b .....	20
5.3.1 Object.....	20
5.3.2 Connecting hardware return loss .....	20
5.3.3 Test method .....	20
5.3.4 Test set-up .....	21
5.3.5 Procedure.....	21
5.3.6 Test report.....	21
5.3.7 Accuracy .....	21
5.4 Near-end crosstalk (NEXT), Test 28c .....	21
5.4.1 Object.....	21
5.4.2 Connecting hardware NEXT.....	21



5.4.3	Test method .....	21
5.4.4	Test set-up .....	22
5.4.5	Procedure.....	22
5.4.6	Test report.....	23
5.4.7	Accuracy .....	23
5.5	Far-end crosstalk (FEXT), Test 28d.....	23
5.5.1	Object.....	23
5.5.2	Connecting hardware FEXT.....	23
5.5.3	Test method .....	23
5.5.4	Test set-up .....	23
5.5.5	Procedure.....	24
5.5.6	Test report.....	24
5.5.7	Accuracy .....	24
5.6	Transfer impedance ( $Z_T$ ), Test 28e .....	25
5.7	Transverse conversion loss (TCL), Test 28f.....	25
5.7.1	Object.....	25
5.7.2	Connecting hardware TCL .....	25
5.7.3	Test method .....	25
5.7.4	Test set-up .....	25
5.7.5	Procedure.....	25
5.7.6	Test report.....	26
5.7.7	Accuracy .....	26
5.8	Transverse conversion transfer loss (TCTL), Test 28g.....	26
5.8.1	Object.....	26
5.8.2	Connecting hardware TCTL.....	26
5.8.3	Test method.....	27
5.8.4	Test set-up .....	27
5.8.5	Procedure.....	27
5.8.6	Test report.....	27
5.8.7	Accuracy .....	27
5.9	Coupling attenuation .....	28
Annex A (informative) Example derivation of mixed mode parameters using the modal decomposition technique .....		29
Annex B (informative) Test pins – Dimensions and references .....		32
Bibliography.....		33
Figure 1 – Diagram of a single ended 4 port device .....		10
Figure 2 – Diagram of a balanced 2 port device .....		10
Figure 4 – Calibration of reference loads .....		14
Figure 5 – Resistor termination networks .....		15
Figure 6 – Definition of reference planes.....		16
Figure 7 – Insertion loss and TCTL measurement .....		20
Figure 8 – NEXT measurement .....		22
Figure 9 – FEXT measurement .....		24
Figure 10 – Return loss and TCL measurement .....		25
Figure A.1 – Voltage and current on balanced DUT.....		29
Figure A.2 – Voltage and current on unbalanced DUT.....		30

Figure B.1 – Example of pin and fixed connector dimensions .....	32
Table 1 – Mixed mode S-parameter nomenclature .....	11
Table 2 – Switch performance recommendations .....	12
Table 3 – Test fixture requirements.....	13
Table 4 – Requirements for terminations at calibration plane .....	13
Table 5 – Interconnection DM return loss requirements.....	18
Table 6 – Overall test setup requirements .....	18

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60512-28-100:2013](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013)

<https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**CONNECTORS FOR ELECTRONIC EQUIPMENT –  
TESTS AND MEASUREMENTS –**
**Part 28-100: Signal integrity tests up to 1 000 MHz  
on IEC 60603-7 and IEC 61076-3 series connectors –  
Tests 28a to 28g**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC 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 National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC 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 National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees 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 IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60512-28-100 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

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

FDIS	Report on voting
48B/2322/FDIS	48B/2332/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 IEC 60512 series, under the general title *Connectors for electronic equipment – Tests and measurements*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 60512-28-100:2013](https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013)

<https://standards.iteh.ai/catalog/standards/sist/f4a1738e-d315-4ce8-bd94-48324cb09d79/sist-en-60512-28-100-2013>