SIST

SLOVENSKI STANDARD
oSIST prEN 50289-1-1:2016

01-oktober-2016

Komunikacijski kabli - Specifikacije za preskusne metode - 1-1. del: Električne preskusne metode - Splošne zahteve

Communication cables - Specifications for test methods - Part 1-1: Electrical test methods - General requirements

Kommunikationskabel - Spezifikationen für Prüfverfahren Teil 1-1: Elektrische Prüfverfahren - Allgemeine Anforderungen

Câbles de communication - Spécifications des méthodes d'essai Partie 1-1: Méthodes d'essais électriques - Prescriptions generals

Ta slovenski standard je istoveten z: prEN 50289-1-1:2016

ICS:

33.120.20	Žice in simetrični kabli	Wires and symmetrical cables

oSIST prEN 50289-1-1:2016 en

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 50289-1-1

August 2016

ICS 33.120.20

Will supersede EN 50289-1-1:2001

English Version

Communication cables - Specifications for test methods - Part 1-1: Electrical test methods - General requirements

Câbles de communication - Spécifications des méthodes d'essai Partie 1-1: Méthodes d'essais électriques - Prescriptions generals

Kommunikationskabel - Spezifikationen für Prüfverfahren Teil 1-1: Elektrische Prüfverfahren - Allgemeine Anforderungen

This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2016-11-04.

It has been drawn up by CLC/TC 46X.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CENELEC 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.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

European foreword

This document [prEN 50289-1-1:2016] has been prepared by CLC/TC 46X "Communication cables".

This document is currently submitted to the Enquiry.

The following dates are proposed:

• latest date by which the existence of this document has to be announced at national level	(doa)	dor + 6 months
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	dor + 12 months
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	dor + 36 months (to be confirmed or modified when voting)

This document will supersede EN 50289-1-1:2001.

EN 50289-1, *Communication cables — Specifications for test methods*, is currently composed with the following parts:

— *Part 1-1: Electrical test methods — General requirements*;

— *Part 1-2: Electrical test methods — DC resistance*;

— *Part 1-3: Electrical test methods — Dielectric strength*;

— *Part 1-4: Electrical test methods — Insulation resistance*;

— *Part 1-5: Electrical test methods — Capacitance*;

— *Part 1-6: Electrical test methods — Electromagnetic performance*;

— *Part 1-7: Electrical test methods — Velocity of propagation*;

— *Part 1-8: Electrical test methods — Attenuation*;

— *Part 1-9: Electrical test methods — Unbalance attenuation (longitudinal conversion loss, longitudinal conversion transfer loss)*;

— *Part 1-10: Electrical test methods — Crosstalk*;

— *Part 1-11: Electrical test methods — Characteristic impedance, input impedance, return loss*;

— *Part 1-12: Electrical test methods — Inductance*;

— *Part 1-13: Electrical test methods — Coupling attenuation or screening attenuation of patch cords / coaxial cable assemblies / pre-connectorised cables*;

— *Part 1-14: Electrical test methods — Coupling attenuation or screening attenuation of connecting hardware*;

— *Part 1-15: Electromagnetic performance — Coupling attenuation of links and channels (Laboratory conditions)*;

— *Part 1-16: Electromagnetic performance — Coupling attenuation of cable assemblies (Field conditions)*;

— *Part 1-17: Electrical test methods — Exogenous Crosstalk ExNEXT and ExFEXT*.

1 Scope

The draft European Standard specifies the electrical test methods for cables used in analogue and digital communication systems.

Part 1 of EN 50289 consists of the following documents:

- Part 1-1 General requirements
- Part 1-2 DC resistance
- Part 1-3 Dielectric strength
- Part 1-4 Insulation resistance
- Part 1-5 Capacitance
- Part 1-6 Electromagnetic performance
- Part 1-7 Velocity of propagation
- Part 1-8 Attenuation
- Part 1-9 Unbalance attenuation (longitudinal conversation loss, longitudinal conversion transfer loss)
- Part 1-10 Crosstalk
- Part 1-11 Characteristic impedance, input impedance, return loss
- Part 1-12 Inductance
- Part 1-13 Coupling attenuation or screening attenuation of patch cords / coaxial cable assemblies / pre-connectorised cables
- Part 1-14 Coupling attenuation or screening attenuation of connecting hardware
- Part 1-15 Coupling attenuation of links and channels (Laboratory conditions)
- Part 1-16 Coupling attenuation of cable assemblies (Field conditions)
- Part 1-17 Exogenous Crosstalk ExNEXT and ExFEXT

Further test details (e.g. temperature, duration) and/or test requirements are given in the relevant cable standard.

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.

EN 50289-1-9, *Communication cables — Specifications for test methods — Part 1-9: Electrical test methods - Unbalance attenuation (longitudinal conversion loss, longitudinal conversion transfer loss)*

EN 50290-1-2, *Communication cables — Specifications for test methods — Part 1-2: Electrical test methods - DC resistance*

EN 61169-16, *Radio-frequency connectors — Part 16: Sectional specification — 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) (IEC 61169-16)*

IEC 60169-15, *Radio-frequency connectors — Part 15: R.F. coaxial connectors with inner diameter of outer conductor 4.13 mm (0.163 in) with screw coupling — Characteristic impedance 50 ohms (Type SMA)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50290-1-2 and the following apply.

3.1
single ended
measurement with respect to a fixed potential, usually ground

3.2
mixed mode (parameter or measurement)
parameters or measurements containing differential mode, common mode, and intermodal S-matrices

3.3
intermodal (parameter or measurement)
parameter or measurement that either sources on the common mode and measures on the differential mode or, sources on the differential mode and measures on the common mode

4 Sampling

4.1 Cable under test (CUT)

Unless otherwise specified in the relevant test method, the length of CUT shall be selected to take into account the dynamic range of the measuring equipment and the frequency range specified to yield the required level of accuracy. The length shall be measured with better accuracy than 1 % unless otherwise stated in the relevant cable specification.

4.2 Pre-conditioning

The CUT shall be pre-conditioned at a constant ambient temperature for such time as to allow the specimen temperature to stabilize according to 6.1.

5 Tests

The tests required and performance characteristics applicable to each type of cable are given in the relevant cable standard.

6 Test conditions

6.1 Ambient temperature

Tests shall be made at an ambient temperature within the range 15°C to 35°C unless otherwise specified.

6.2 Tolerance on temperature values

Unless otherwise specified in the relevant specification, the tolerance on temperature shall be ± 2°C.

6.3 Frequency and waveform of test voltages for dielectric strength test

Unless otherwise specified, the test voltage shall be in the frequency range 40 Hz to 62 Hz of approximately sine-wave form, the peak ratio value/r.m.s. value being equal to $\sqrt{2}$ with a tolerance of ± 7 %. The values given are r.m.s.

6.4 Frequency range and stability for frequency related measurements

The required frequency range is specified in the relevant sectional specification.

The sweep shall be linear or logarithmic such that:

$$f_{step} = \frac{f_{stop} - f_{start}}{n-1}$$ for linear sweep and

$$K = \left(\frac{f_{stop}}{f_{start}}\right)^{1/(n-1)}$$ for logarithmic sweep

where

f_{start} lowest specified frequency;

f_{stop} highest specified frequency;

f_{step} linear frequency increment, constant over the whole specified frequency range;

n number of frequency points;

K ratio of two successive frequency points at logarithmic sweep.

The minimum number of frequency points shall be chosen to point out frequency dependent cable characteristics. Unless otherwise specified the minimum number of frequency points shall be

200 points in the range 10 kHz – 100 kHz,
200 points in the range 100 kHz – 1 MHz,
200 points in the range 1 MHz – 16 MHz,
400 points in the range 1 MHz – 100 MHz,
800 points in the range 1 MHz – 600 MHz,
1 000 points in the range 1 MHz – 1 000 MHz,
1 600 points in the range 1 MHz – 2 000 MHz.

6.5 Measurement on drums

Unless otherwise specified or special cable-specific characteristics need to be taken into account, the cables shall be measured on drums or coils.

7 Measurement methods and equipment

7.1 Calibration

Equipment calibration shall be considered part of the quality system.

7.2 Requirements for balanced to unbalanced converters (Baluns)

Several classes of baluns with different performance levels are defined. This is in order to facilitate measurements in different frequency ranges with commercially available baluns as appropriate. The baluns may be balun transformers or 180° hybrids with attenuators to improve matching if needed (see Figure 1).

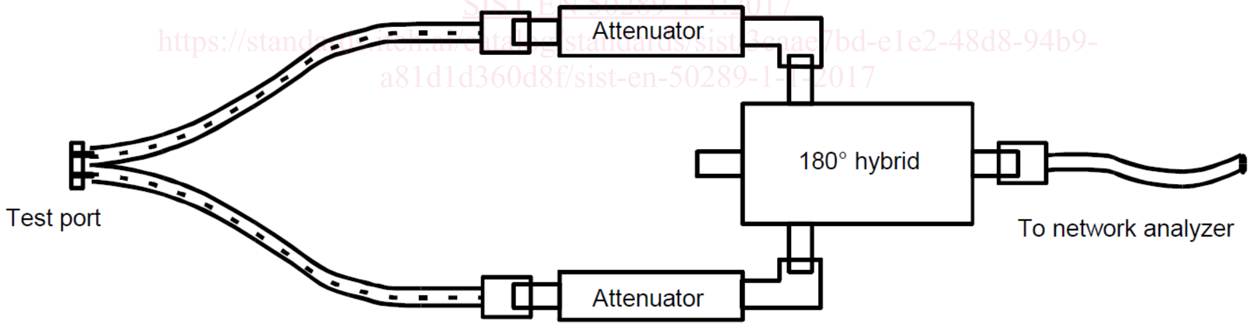

Figure 1 — 180° hybrid used as a balun

Baluns shall be RFI shielded and shall comply with the requirements given in Table 1. Depending on the frequency range different requirements are specified. For frequencies higher than 1 GHz balunless measurement technique is recommended (see clause 7.3).

Generally, it is advantageous to choose a balun with the same common mode impedance as the cable under test. However, in practice this is hardly possible as it is unreasonable to provide separate measurements equipment for each cable type. Often the best performance for differential mode is achieved when the centre tap of the secondary winding of the balun is grounded; meaning the nominal common mode impedance is 25 Ω. Then the results can directly be compared to results achieved by balunless measurement technique when 50 Ω ports are used without mathematical impedance transformation of the latter results.

In case of balance measurements the centre tap of the secondary winding of the balun cannot be grounded. To compare balance measurement results achieved with balun-based measurement technique to results achieved with balunless measurements technique the procedures described in EN 50289-1-9 shall be considered. Unless otherwise specified the rules specifying the common mode termination for balance measurements according to EN 50289-1-9 shall be applied in case of doubt. The reference common mode impedance specified accordingly may be different to the reference common mode impedance of the cabling system the cable is intended to be used for.

Table 1 — Test balun performance characteristics

Parameter	Class A 250 1 to 250 MHz	Class A 500 1 to 500 MHz	Class A 1000 1 to 1 000 MHz	Class A 2000 1 to 2 000 MHz
Impedance, primary[a]	50 Ω unbalanced	50 Ω unbalanced	50 Ω unbalanced	50 Ω unbalanced
Impedance, secondary	Matched balanced [d]	Matched balanced [d]	Matched balanced [d]	Matched balanced [d]
Insertion loss[e]	3 dB maximum	2 dB maximum	3 dB maximum	3 dB, 1-3 MHz 2 dB, 3-15 MHz 2 dB, 15-1 000 MHz 3 dB, 1 000-2 000 MHz
Return loss secondary, minimum	20 dB	12 dB, 1-15 MHz 20 dB, 15-500 MHz	12 dB, 4-15 MHz 20 dB, 15-550 MHz 17,5 dB, 550-600 MHz 10 dB, 600-1000 MHz	8 dB, 1-3 MHz 12 dB, 3-15 MHz 20 dB, 15-1 000 MHz 18 dB, 1 000-2 000 MHz
Return loss, common mode[b], minimum	10 dB	15 dB, 1-15 MHz 20 dB, 15-400 MHz 15 dB, 400-500 MHz	15 dB, 4-15 MHz 20 dB, 15-400 MHz 15 dB, 400-600 MHz 10 dB, 600-1000 MHz	6 dB, 1-3 MHz 10 dB, 3-500 MHz ffs., 500-2 000 MHz
Power rating	0,1 Watt minimum	0,1 Watt minimum	0,1 Watt minimum	0,1 Watt minimum
Longitudinal balance[c], minimum	60 dB	60 dB, 1-100 MHz 50 dB, 100-500 MHz	60 dB, 4-350 MHz 50 dB, 350-600 MHz 40 dB, 600-1 000 MHz	60 dB, 1-100 MHz 50 dB, 100-500 MHz 42 dB, 500-1 000 MHz 34 dB, 1 000-2 000 MHz
Output signal balance[c], minimum	50 dB	50 dB	60 dB, 4-350 MHz 50 dB, 350-600 MHz 40 dB, 600-1 000 MHz	ffs.
Common mode rejection[c], minimum	50 dB	50 dB	50 dB, 4-600 MHz 40 dB, 600-1 000 MHz	50 dB, 1-500 MHz 42 dB, 500-1 000 MHz 34 dB, 1 000-2 000 MHz

[a] Primary impedance may differ, if necessary to accommodate analyser outputs other than 50 Ω.

[b] Measured either by connecting the balanced output terminals together and measuring the return loss. The unbalanced balun input terminal shall be terminated by a 50 Ω load. Or measured at the common-mode port – if available – while terminating the balanced port for differential and common mode.

[c] Measured per ITU-T Recommendations G.117 and O.9.

[d] For 120 Ω cables, 120 Ω baluns will be used only in cases where it is requested by the user. Usually 100 Ω baluns will be used.

[e] In case separate attenuators are used, they shall be excluded from the insertion loss measurement.

NOTE An overview of the configuration for the measurement of certain parameters is provided by EN 60512-27-100.

7.3 Balun-less test method

7.3.1 Test instrumentation

The test procedures hereby described require the use of a vector network analyser or similar test equipment. The analyser shall have the capability of full 4-port calibration and shall include the capability for isolation calibrations. The analyser shall cover at least the full frequency range of the cable or cabling under test (CUT).

Measurements shall be taken using a mixed mode test set-up, which is often referred to as an unbalanced, modal decomposition or balun-less setup. This allows measurements of balanced devices without use of an RF balun in the signal path. With such a test set-up, all balanced and unbalanced parameters can be measured over the full frequency range.

Such a configuration allows testing with both a common or differential mode stimulus and responses, ensuring that intermodal parameters can be measured without reconnection.

A 16 port network analyser is required to measure all combinations of a 4 pair device without external switching; however, the network analyser shall have a minimum of 2 ports to enable the data to be collated and calculated.

It shall be noted that the use of a 4-port analyser will involve successive repositioning of the measurement ports in order to measure any given parameter.

A 4-port network analyser is recommended as a minimum number of ports, as this will allow the measurement of the full 16 term mixed mode S-parameter matrix on a given pair combination without switching or reconnection in one direction.

In order to minimize the reconnection of the CUT for each pair combination, the use of an RF switching unit is also recommended.

Each conductor of the pair or pair combination under test shall be connected to a separate port of the network analyser, and results are processed either by internal analysis within the network analyser or by an external application.

Reference loads and through connections are needed for the calibration of the set-up. Requirements for the reference loads are given in 7.3.5. Termination loads are needed for termination of pairs, used and unused, which are not terminated by the network analyser. Requirements for the termination loads are given in 7.3.7.

7.3.2 Measurement precautions

To assure a high degree of reliability for transmission measurements, the following precautions are required:

a) Consistent and stable resistor loads shall be used throughout the test sequence.

b) Cable and adapter discontinuities, as introduced by physical flexing, sharp bends and restraints shall be avoided before, during and after the tests.

c) Consistent test methodology and termination resistors shall be used at all stages of transmission performance qualifications. The relative spacing of conductors in the pairs shall be preserved throughout the tests to the greatest extent possible.

d) The balance of the cables shall be maintained to the greatest extent possible by consistent conductor lengths, pair twisting and lay up of the screen to the point of load.

e) The sensitivity to set-up variations for these measurements at high frequencies demands attention to details for both the measurement equipment and the procedures.

7.3.3 Mixed mode S-parameter nomenclature

The test methods specified in this document are based on a balun-less test setup in which all terminals of a device under test are measured and characterized as single-ended (SE) ports, i.e. signals (RF voltages and currents) are defined relative to a common ground. For a device with 4 terminals, a diagram is given in Figure 2.

Figure 2 — Diagram of a single-ended 4-port device

The 4-port device in figure 2 is characterized by the 16 term SE S-matrix given in Formula (1), in which the S-parameter S_{ba} expresses the relation between a single-ended response on port "b" resulting from a single ended stimulus on port "a".

$$S = \begin{bmatrix} S_{11} & S_{12} & S_{13} & S_{14} \\ S_{21} & S_{22} & S_{23} & S_{24} \\ S_{31} & S_{32} & S_{33} & S_{34} \\ S_{41} & S_{42} & S_{34} & S_{44} \end{bmatrix} \quad (1)$$

For a balanced device, each port is considered to consist of a pair of terminals (= a balanced port) as opposed to the SE ports defined above, see Figure 3.

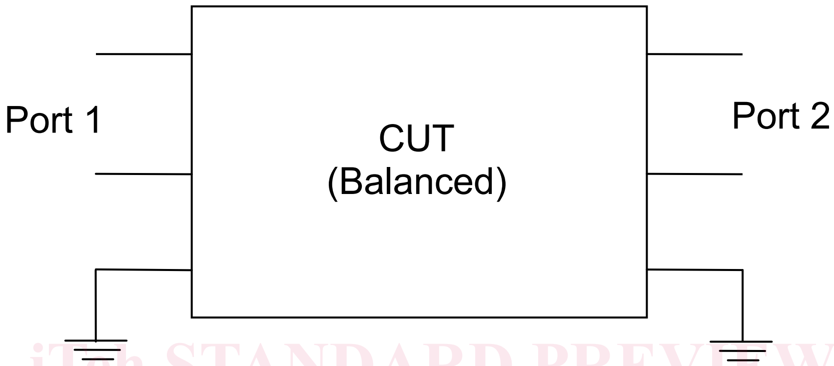

Figure 3 — Diagram of a balanced 2 port device

In order to characterize the balanced device, both the differential mode and the common mode signals on each balanced port shall be considered. The device can be characterized by a mixed mode S-matrix that includes all combinations of modes and ports, e.g. the mixed mode S-parameter S_{DC21} that expresses the relation between a differential mode response on port 2 resulting from a common mode stimulus on port 1. Using this nomenclature, the full set of mixed mode S-parameters for a 2-port can be presented as in table 2.

Table 2 — Mixed mode S-parameter nomenclature

		Differential mode stimulus		Common mode stimulus	
		Port 1	Port 2	Port 1	Port 2
Differential mode response	Port 1	S_{DD11}	S_{DD12}	S_{DC11}	S_{DC12}
	Port 2	S_{DD21}	S_{DD22}	S_{DC21}	S_{DC22}
Common mode response	Port 1	S_{CD11}	S_{CD12}	S_{CC11}	S_{CC12}
	Port 2	S_{CD21}	S_{CD22}	S_{CC21}	S_{CC22}

A 4-terminal device can be represented both as a 4-port SE device as in figure 2 characterized by a single ended S-matrix (Formula (1)) and as a 2 port balanced device as in figure 3 characterized by a mixed mode S-matrix (see table 2). As applying a SE signal to a port is mathematically equivalent to applying superposed differential and common mode signals, the SE and the mixed mode characterizations of the device are interrelated. The conversion from SE to mixed mode S-parameters is given in Annex A. Making use of this conversion, the mixed mode S-parameters may be derived from the measured SE S-matrix.

7.3.4 Coaxial cables and interconnect for network analysers

Assuming that the characteristic impedance of the network analyser is 50 Ω, coaxial cables used to interconnect the network analyser, switching matrix and the test fixture shall be of 50 Ω characteristic impedance and of low transfer impedance (double screen or more).