SLOVENSKI STANDARD **SIST EN 60512-25-7:2005**

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Konektorji za elektronsko opremo – Preskusi in meritve – 25-7. del: Preskus 25g – Impedanca, odbojni koeficient in razmerje napetostnega stojnega vala (IEC 60512-25-7:2004)

Connectors for electronic equipment – Tests and measurements – Part 25-7: Test 25g – Impedance, reflection coefficient and voltage standing wave ratio (VSWR) (IEC 60512-25-7:2004)

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English version

Connectors for electronic equipment – Tests and measurements Part 25-7: Test 25g – Impedance, reflection coefficient and voltage standing wave ratio (VSWR)

(IEC 60512-25-7:2004)

Connecteurs pour équipements électroniques –
Essais et mesures
Partie 25-7: Essai 25g –
Impédance, coefficient de réflexion et rapport d'ondes stationnaires en tension (VSWR)
(CEI 60512-25-7:2004)

Steckverbinder für elektronische Einrichtungen -
Mess- und Prüfverfahren
Teil 25-7: Prüfung 25g –
Impedanz, Reflexionskoeffizient und Spannungsstehwellenverhältnis
(IEC 60512-25-7:2004)

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CENELEC
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Foreword

The text of document 48B/1479/FDIS, future edition 1 of IEC 60512-25-7, 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 was approved by CENELEC as EN 60512-25-7 on 2005-03-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2005-12-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-03-01

Endorsement notice

The text of the International Standard IEC 60512-25-7:2004 approved by CENELEC as a European Standard without any modification.

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Connectors for electronic equipment – Tests and measurements –

Part 25-7: Test 25g – Impedance, reflection coefficient, and voltage standing wave ratio (VSWR)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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International Standard IEC 60512-25-7 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/1479/FDIS	48B/1506/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.

IEC 60512-25 consists of the following parts, under the general title *Connectors for electronic equipment – Tests and measurements:*

Part 25-1: Test 25a – Crosstalk ratio

Part 25-2: Test 25b – Attenuation (insertion loss)

Part 25-3: Test 25c – Rise time degradation

Part 25-4: Test 25d – Propagation delay

Part 25-5: Test 25e – Return loss

Part 25-6: Test 25f – Eye pattern and jitter

Part 25-7: Test 25g – Impedance, reflection coefficient, and voltage standing wave ratio (VSWR)

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

CONNECTORS FOR ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 25-7: Test 25g – Impedance, reflection coefficient, and voltage standing wave ratio (VSWR)

1 Scope and object

This part of IEC 60512 applies to interconnect assemblies, such as electrical connectors and cable assemblies, within the scope of IEC technical committee 48.

This standard describes test methods to measure impedance, reflection coefficient, and voltage standing wave ratio (VSWR) in the time and frequency domains.

NOTE These test methods are written for test professionals who are knowledgeable in the electronics field and are trained to use the referenced equipment. Because the measurement values are heavily influenced by the fixturing and equipment, this method cannot describe all of the possible combinations. The major equipment manufacturers provide application notes for a more in-depth technical description of how to optimize the use of their equipment. It is imperative that the referencing document include the necessary description and sketches for the test professional to understand how to set up and perform the requested measurements.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
measurement system rise time
rise time measured with the fixture in place, without the specimen, and with filtering (or normalization). Rise time is typically measured from 10 % to 90 % levels

2.2
specimen environment impedance
impedance presented to the signal conductors by the fixture. This impedance is a result of transmission lines, termination resistors, attached receivers or signal sources, and fixture parasitics

2.3
reflection coefficient
ratio of the reflected to incident voltages at any given point. The reflection coefficient is given by

$$\Gamma = \frac{V_{\text{reflected}}}{V_{\text{incident}}} = \frac{Z_{\text{L}} - Z_{\text{O}}}{Z_{\text{L}} + Z_{\text{O}}} = s_{11}$$

where Z_{L} is the fixture or specimen impedance and Z_{O} is the specimen environment impedance.

NOTE In the time domain, the reflection coefficient symbol typically used is rho (ρ), while gamma (Γ) is used for frequency-domain measurements.

2.4
impedance
total opposition that a circuit offers to the flow of alternating current at a particular frequency. It is a combination of the resistance (R) and reactance (X) measured in ohms (Ω). The equation for impedance as a function of s-parameters is:

$$Z = Z_0 \frac{1+s_{11}}{1-s_{11}} = R + \mathrm{j}X = Z_0 \left[\frac{(1+\rho)}{(1-\rho)} \right]$$

2.5
voltage standing wave ratio
VSWR
ratio of the maximum magnitude of the voltage on a line to the minimum magnitude at any given point. VSWR can be expressed by the following equations:

$$\mathrm{VSWR} = \frac{|V_{\mathrm{max}}|}{|V_{\mathrm{min}}|} = \frac{|V_{\mathrm{inc}} + V_{\mathrm{refl}}|}{|V_{\mathrm{inc}} - V_{\mathrm{refl}}|}$$

$$\mathrm{VSWR} = \frac{(1+|\Gamma|)}{(1-|\Gamma|)}$$

2.6
scattering parameter (s-parameter)
s_{11}
reflection coefficient at the input port of the device under test, defined as the ratio of the reflected voltage to the incident voltage

2.7
termination (electronics usage)
impedance connected to the end of a transmission line, typically to minimize reflected energy on the line

2.8
step amplitude
voltage difference between the 0 % and 100 % levels, ignoring overshoot and undershoot

3 Test resources

Care should be taken when establishing the equivalence between time- and frequency-domain measurements. The relationship between the two is complex, and the application of bandwidth = (0,35/rise time) should not be used without further computations and understanding.

3.1 Equipment

3.1.1 Time domain

3.1.1.1 A Time Domain Reflectometer (TDR) is preferred as the measurement accuracy is improved with the use of a step function, although an oscilloscope and pulse generator may be used. A network analyzer may be used with FFT (Fast Fourier Transform) software.

NOTE The test professional should be aware of limitations of any mathematical operation performed by an instrument (for example, FFT).

3.1.1.2 Variable rise time

A means should be provided for varying the signal rise time if required. This may be included within the test equipment itself, or possibly through additional filtering or software.

NOTE The test professional should be aware of limitations of any mathematical operation performed by an instrument or software; for example, normalization or filtering.

3.1.1.3 Differential measurements

The test equipment shall have the capability to perform differential measurements directly, or provisions shall be made to calculate the impedance from multiple single-ended measurements.

3.1.2 Frequency domain

3.1.2.1 A vector network analyzer or impedance analyzer shall be used.

NOTE 1 The test professional should be aware of the frequency limitations of the fixture.

NOTE 2 The test professional should be aware of any limitations of any mathematical functions performed (for example, normalization, inverse FFT, or software filtering.)

3.1.2.2 Differential measurements

For differential measurements, a network analyzer and baluns may be used.

NOTE The test professional should be aware of the electrical characteristics of the baluns that become part of the test fixture and can significantly affect the measurement.

3.2 Fixture

The fixture(s) shall allow for enough measurements throughout the specimen so that variations in geometries, materials, transmission paths, etc. may be demonstrated and provide a representative sampling of specimen performance.

NOTE The fixture geometry and materials will impact the measurements due to the fixture parasitics. Usually, the intended use of the product dictates the most meaningful way to fixture it.

3.2.1 Specimen environment impedance

Unless otherwise specified in the referencing document, the specimen environment impedance shall match the impedance of the test equipment. Typically this will be 50 Ω for single-ended measurements and 100 Ω for differential measurements.

3.2.2 Terminations

When using termination resistors, care should be taken to minimize the parasitic reactances of the terminators over the range of test frequencies (see Annex E).

3.2.3 Calibration features

See Annex C for calibration and reference traces.

NOTE The term "calibration" used in this document is not to be confused with the periodic factory equipment calibration. Calibration is used in the sense of characterizing the fixture so that when the "fixture plus specimen" measurement is taken, the characteristics of the specimen alone can be accurately determined.

3.2.3.1 Time domain

The fixture shall include features such that the near and far ends of the specimen may be determined in time (see Annex B). The calibration plane should be as close to the specimen as possible. When the fixture includes a pc board with line traces connecting two connectors, it shall have a reference trace(s) that will allow the measurement system rise time to be measured. The reference trace shall have starting points and end points at the same location as the DUT (device under test) starting point and end point. This is because the reference trace(s) length shall be the same as the pc board traces.

3.2.3.2 Frequency domain

It is necessary to include fixture features that will allow for the open, short, and load measurements to be taken. This may be accomplished by one of two methods. Firstly, provide reference traces that include the open, load and short standards. Secondly, provide an interface where these standards can be applied directly to the end of the fixture and immediately before the input plane of the device under test. When using the open/short method, the fixture shall include features such that measurements may be conducted with the far end of the driven line both open-circuited and short-circuited.

NOTE Other calibration techniques (such as through-reflect-line) may be used. The fixture should incorporate features appropriate to that (these) calibration method(s).

3.2.4 Single-ended

The fixture shall allow one signal line to be driven at a time. The far end of the driven line shall be terminated in the specimen environment impedance (typically 50 Ω). It is recommended that a length of transmission line be added after the sample that has a propagation delay greater than twice the measurement system rise time. Unless otherwise specified in the referencing document,

– a 1:1 signal to ground ratio shall be used;
– designated ground lines shall be commoned on both the near and far end;
– adjacent signal lines shall be terminated in the specimen environment impedance.

3.2.5 Differential

The fixture shall allow one signal pair to be driven at a time. The driven pair shall be terminated in the specimen environment impedance (typically 100 Ω). It is recommended that a length of transmission line be added after the specimen that has a propagation delay greater than twice the measurement system rise time. Unless otherwise specified in the referencing document,

– a 2:1 signal to ground ratio shall be used (one signal pair for each ground return);
– designated ground lines shall be commoned on both the near and far end;
– adjacent signal lines shall be terminated in the specimen environment impedance.

NOTE For differential applications in the frequency domain using a 2-port network analyzer, the fixture will include the use of baluns.

4 Test specimen

4.1 Description

For this test procedure, the test specimen shall be as follows.

4.1.1 Separable connectors

A mated connector pair.

4.1.2 Cable assembly

Assembled connectors and cables, and mating connectors.

5 Test procedure

5.1 Time domain

5.1.1 Calibrate the equipment and fixture according to the manufacturer's specified measurement techniques using precision impedance standards and/or cabling. The calibration plane is to be directly at the input interface of the specimen (see 3.2.3.1 for more detailed information).

5.1.2 Connect the TDR signal line(s) to the reference line(s) of the test fixture.

5.1.3 Unless otherwise specified in the referencing document, the signal rise time shall be the fastest signal of which the equipment is capable. If a slower signal rise time is also desired to approximate the application conditions, one of the rise times in Table 1 may be used. Measure and record the measurement system rise time from the reference line, as shown in Figure A.1.