SLOVENSKI STANDARD
SIST EN 61000-4-7:2003/A1:2009

01-september-2009

Elektromagnetna združljivost (EMC) - 4-7. del: Preskusne in merilne tehnike - Splošno vodilo za meritve in merilno opremo za merjenje harmonikov in medharmonikov v napajalnih omrežjih in nanje priključeni opremo (IEC 61000-4-7:2002/A1:2008)

Electromagnetic compatibility (EMC) -- Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto

Elektromagnetische Verträglichkeit (EMV) -- Teil 4-7: Prüf- und Messverfahren - Allgemeiner Leitfaden für Verfahren und Geräte zur Messung von Oberschwingungen und Zwischenharmonischen in Stromversorgungsnetzen und angeschlossenen Geräten

Compatibilité électromagnétique (CEM) -- Partie 4-7: Techniques d'essai et de mesure - Guide général relatif aux mesures d'harmoniques et d'interharmoniques, ainsi qu'à l'appareillage de mesure, applicable aux réseaux d'alimentation et aux appareils qui y sont raccordés

Ta slovenski standard je istoveten z: **EN 61000-4-7:2002/A1:2009**

ICS:

33.100.20 Imunost Immunity

SIST EN 61000-4-7:2003/A1:2009 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61000-4-7/A1

March 2009

ICS 33.100.10; 33.100.20

English version

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This amendment A1 modifies the European Standard EN 61000-4-7:2002; it was approved by CENELEC on 2009-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment 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 Central Secretariat or to any CENELEC member.

This amendment 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 Central Secretariat has the same status as the official versions.

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

CENELEC

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

Central Secretariat: avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 77A/645/FDIS, future amendment 1 to IEC 61000-4-7:2002, prepared by SC 77A, Low frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 61000-4-7:2002 on 2009-03-01.

The following dates were fixed:

– latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2009-12-01
– latest date by which the national standards conflicting with the amendment have to be withdrawn	(dow)	2012-03-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of amendment 1:2008 to the International Standard IEC 61000-4-7:2002 was approved by CENELEC as an amendment to the European Standard without any modification.

***Replace** Annex ZA of EN 61000-4-7:2002 by:*

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. 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.

Publication	Year	Title	EN/HD	Year
IEC 60038	-[1]	IEC standard voltages[2]	HD 472 S1 + corr. February A1	1989[3] 2002 1995
IEC 60050-161	-[1]	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
IEC 61000-2-2	-[1]	Electromagnetic compatibility (EMC) - Part 2-2: Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems	EN 61000-2-2	2002[3]
IEC 61000-3-2	-[1]	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN 61000-3-2	2006[3]
IEC 61000-3-12	-[1]	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase	EN 61000-3-12	2005[3]

[1] Undated reference.

[2] The title of HD 472 S1 is: Nominal voltages for low-voltage public electricity supply systems.

[3] Valid edition at date of issue.

IEC 61000-4-7

Edition 2.0 2008-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto

Compatibilité électromagnétique (CEM) – Partie 4-7: Techniques d'essai et de mesure – Guide général relatif aux mesures d'harmoniques et d'interharmoniques, ainsi qu'à l'appareillage de mesure, applicable aux réseaux d'alimentation et aux appareils qui y sont raccordés

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX T

ICS 33.100.10; 33.100.20

ISBN 2-8318-9848-X

FOREWORD

This amendment has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

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

FDIS	Report on voting
77A/645/FDIS	77A/651/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base 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.

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2 Normative references

Insert, in the existing list, the following standards:

IEC 60038, *IEC standard voltages*

IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase*

Delete from the existing list the following standard:

IEC 61967-1, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 1: Measurement conditions and definitions*

Pages 15 and 17

3.1 Definitions related to frequency analysis

Replace the entire subclause, including the NOTES, by the following new text:

Notations: The following notations are used in the present guide for the Fourier series development because it is easier to measure phase angles by observations of the zero crossings:

$$f(t) = c_0 + \sum_{k=1}^{\infty} c_k \sin\left(\frac{k}{N}\omega_1 t + \varphi_k\right) \tag{1}$$

with:

$$\begin{cases} c_k = |b_k + j a_k| = \sqrt{a_k^2 + b_k^2} \\ Y_{C,k} = \dfrac{c_k}{\sqrt{2}} \\ \varphi_k = \pi + \arctan\left(\dfrac{a_k}{b_k}\right) \text{ if } b_k < 0 \qquad \varphi_k = \arctan\left(\dfrac{a_k}{b_k}\right) \text{ if } b_k > 0 \\ \varphi_k = \dfrac{\pi}{2} \text{ if } b_k = 0 \text{ and } a_k > 0 \qquad \varphi_k = -\dfrac{\pi}{2} \text{ if } b_k = 0 \text{ and } a_k < 0 \\ \varphi_k = 0 \text{ if } |b_k| \le \varepsilon \text{ and } |a_k| \le \varepsilon, \\ \quad \text{with } \varepsilon = 0{,}05\,\% \ U_{nom} \text{ and } \varepsilon = 0{,}15\,\% \ I_{nom} \\ \quad \text{or } \varepsilon = 0{,}15\,\% \ U_{nom} \text{ and } \varepsilon = 0{,}5\,\% \ I_{nom} \\ \quad \text{respectively, see table 1 in IEC 61000-4-7} \end{cases} \tag{2}$$

and:

$$\begin{cases} b_k = \dfrac{2}{T_N}\displaystyle\int_0^{T_N} f(t) \times \sin\left(\frac{k}{N}\omega_1 t\right) \mathrm{d}t \\ a_k = \dfrac{2}{T_N}\displaystyle\int_0^{T_N} f(t) \times \cos\left(\frac{k}{N}\omega_1 t\right) \mathrm{d}t \\ c_0 = \dfrac{1}{T_N}\displaystyle\int_0^{T_N} f(t)\,\mathrm{d}t \end{cases} \tag{3}$$

NOTE 1 The above definition setting φ_k to zero for the cases where b_k and a_k have very small values provides guidance to instrument manufacturers, as phase measurements of very small amplitudes may result in very large deviations, hence there is no requirement to measure phase for such small signals.

ω_1 is the angular frequency of the fundamental ($\omega_1 = 2\pi f_{H,1}$);

T_N is the width (or duration) of the time window; the time window is that time span of a time function over which the Fourier transform is performed;

c_0 is the d.c. component;

c_k is the amplitude of the component with frequency $f_{C,k} = \dfrac{k}{N} f_{H,1}$;

$Y_{C,k}$ is the r.m.s. value of component c_k;

$f_{H,1}$ is the fundamental frequency of the power system;

k is the ordinal number (order of the spectral component) related to the frequency resolution $\left(f_{C,1} = 1/T_N\right)$;

N is the number of fundamental periods within the window width;

φ_k is the phase angle of spectral line k.

NOTE 2 Strictly speaking these definitions apply to steady-state signals only. The Fourier series is actually in most cases performed digitally, i.e. as a Discrete Fourier Transform DFT, or a variant thereof, being the FFT.

The analogue signal $f(t)$ which has to be analyzed is sampled, A/D-converted and stored. Each group of M samples forms a time window on which DFT is performed. According to the principles of Fourier series expansion, the window width T_N determines the frequency resolution $f_{C,1} = 1/T_N$ (i.e. the frequency separation of the spectral components) for the analysis. Therefore the window width T_N must be an integer multiple N of the fundamental period T_1 of the system voltage: $T_N = N \times T_1$. The sampling rate is in this case $f_s = M/(NT_1)$ (where M = number of samples within T_N).

Before DFT-processing, the samples in the time window are often weighted by multiplying them with a special symmetrical function ('windowing function'). However, for periodic signals and synchronous sampling it is preferable to use a rectangular weighting window which multiplies each sample by unity.

The DFT-processor yields the orthogonal Fourier-coefficients a_k and b_k of the corresponding spectral-component frequencies $f_{C,k} = k/T_N$, k = 0, 1, 2 ... M-1. However, only k values up to and including half of the maximum value are useful, the other half just duplicates them.

Under synchronized conditions, the component of harmonic order h related to the fundamental frequency $f_{H,1}$ appears as the spectral component of order k, where $k = hN$.

NOTE 3 The Fast Fourier Transform FFT is a special algorithm allowing short computation times. It requires that the number of samples M be an integer power of 2, $M = 2^i$, with $i \geq 10$ for example.

NOTE 4 The symbol Y is replaced, as required by the symbol I for currents, by the symbol U for voltages. Index C qualifies the variable as spectral component.

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3.2 Definitions related to harmonics

Replace the existing terms and definitions 3.2.1 to 3.2.5, including NOTES, if any, by the following:

3.2.1
harmonic frequency
$f_{H,h}$
frequency which is an integer multiple of the fundamental frequency of the power system ($f_{H,h} = h \times f_{H,1}$)

NOTE The harmonic frequency $f_{H,h}$ is identical with the component frequency $f_{C,k}$ with $k = h \times N$.

3.2.2
harmonic order
h
(integer) ratio of a harmonic frequency to the fundamental frequency of the power system. In connection with the analysis using DFT and synchronisation between $f_{H,1}$ and f_s (sampling rate), the harmonic order h corresponds to the spectral component $k = h \times N$ (k = number of the spectral component, N = number of periods of the fundamental frequency in time window T_N)

3.2.3
r.m.s. value of a harmonic component
$Y_{H,h}$
r.m.s. value of one of the components having a harmonic frequency in the analysis of a non-sinusoidal waveform

For brevity, such a component may be referred to simply as a “harmonic”

NOTE 1 The harmonic component $Y_{H,h}$ is identical with the spectral component $Y_{C,k}$ with $k = h \times N$; ($Y_{H,h} = Y_{C,h \times N}$). The symbol *Y* is replaced, as required by the symbol *I* for currents, by the symbol *U* for voltages. The index H qualifies the variable I *or* U as harmonic.

NOTE 2 For the purposes of this standard, the time window has a width of N = 10 (50 Hz systems) or N = 12 (60 Hz system) fundamental periods, i.e. approximately 200 ms (see 4.4.1). This yields $Y_{H,h} = Y_{C,10 \times h}$ (50 Hz systems) and $Y_{H,h} = Y_{C,12 \times h}$ (60 Hz systems).

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3.2.4
r.m.s. value of a harmonic group
$Y_{g,h}$
square root of the sum of the squares of the r.m.s. value of a harmonic and the spectral components adjacent to it within the time window, thus summing the energy contents of the neighbouring components with that of the harmonic proper. See also equation 8 and Figure 4. The harmonic order is given by the harmonic considered.

NOTE The symbol Y is replaced, as required by the symbol I for currents, by the symbol U for voltages.

3.2.5
r.m.s. value of a harmonic subgroup
$Y_{sg,h}$
square root of the sum of the squares of the r.m.s. value of a harmonic and the two spectral components immediately adjacent to it. For the purpose of including the effect of voltage fluctuation during voltage surveys, a subgroup of output components of the DFT is obtained by summing the energy contents of the frequency components directly adjacent to a harmonic with that of the harmonic proper. (See also equation 9 and Figure 6.) The harmonic order is given by the harmonic considered

NOTE The symbol Y is replaced, as required by the symbol I for currents, by the symbol U for voltages.

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3.3 Definitions related to distortion factors

Replace the existing terms and definitions 3.3.1 to 3.3.4, including NOTES, if any, by the following:

3.3.1
total harmonic distortion
THD
THD_Y (symbol)
ratio of the r.m.s. value of the sum of all the harmonic components ($Y_{H,h}$) up to a specified order (h_{max}) to the r.m.s. value of the fundamental component ($Y_{H,1}$):

$$THD_Y = \sqrt{\sum_{h=2}^{h_{max}} \left(\frac{Y_{H,h}}{Y_{H,1}} \right)^2} \qquad (4)$$

NOTE 1 The symbol Y is replaced, as required, by the symbol I for currents or by the symbol U for voltages.

NOTE 2 The value of h_{max} is 40 if no other value is defined in a standard concerned with limits (IEC 61000-3 series).

3.3.2
group total harmonic distortion
THDG
$THDG_Y$ (symbol)
ratio of the r.m.s. value of the harmonic groups ($Y_{g,h}$) to the r.m.s. value of the group associated with the fundamental ($Y_{g,1}$):

$$THDG_Y = \sqrt{\sum_{h=h_{min}}^{h_{max}} \left(\frac{Y_{g,h}}{Y_{g,1}} \right)^2} \qquad \text{where} \quad h_{min} \geq 2 \qquad (5)$$

NOTE 1 The symbol Y is replaced, as required, by the symbol I for currents or by the symbol U for voltages.

NOTE 2 The value of h_{min} is 2 and that of h_{max} is 40 if no other values are defined in a standard concerned with limits (for example IEC 61000-3 series).