
Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 7: General guide on harmonics and interharmonics measurement and instrumentation, for power supply systems and equipment connected thereto (IEC 1000-4-7:1991)

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

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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

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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

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Part 4: Testing and measurement techniques
Section 7: General guide on harmonics and
interharmonics measurements and instrumentation,
for power supply systems and equipment connected
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(IEC 1000-4-7:1991)

Compatibilité électromagnétique
(CEM)

Partie 4: Techniques d'essai et
de mesure

Section 7: Guide général relatif
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d'interharmoniques, ainsi qu'à
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(CEI 1000-4-7:1991)

Elektromagnetische
Verträglichkeit (EMV)

Teil 4: Prüf- und
Meßverfahren

Hauptabschnitt 7: Allgemeiner
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Geräte zur Messung von
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Zwischenharmonischen in
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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 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 Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 1000-4-7:1991 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 61000-4-7 on 9 December 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-12-01
- latest date of withdrawal of conflicting national standards (dow) 1993-12-01

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, annex A is informative and annex ZA is normative.

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The text of the International Standard IEC 1000-4-7:1991 was approved by CENELEC as a European Standard without any modification.

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ANNEX ZA (normative)

OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD
WITH THE REFERENCES OF THE RELEVANT EUROPEAN PUBLICATIONS

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

IEC Publication	Date	Title	EN/HD	Date
50(161)	1990	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
348	1978	Safety requirements for electronic measuring apparatus	HD 401 S1	1980
555-1	1982	Disturbances in supply systems caused by household appliances and similar electrical equipment Part 1: Definitions	EN 60555-1	1987
555-2 (mod)	1982	Part 2: Harmonics	EN 60555-2*	1987
801-2	1984*	Electromagnetic compatibility for industrial-process measurement and control equipment - part 2: Electrostatic discharge requirements	HD 481.2 S1	1987

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* EN 60555-2:1987 includes A1:1985 to IEC 555-2
IEC 801-2:1991 was harmonized as EN 60801-2:1993

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Compatibilité électromagnétique (CEM)

Partie 4:

Techniques d'essai et de mesure

Section 7: 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

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Electromagnetic compatibility (EMC)

Part 4:

Testing and measurement techniques

Section 7: General guide on harmonics and inter-

harmonics measurements and instrumentation,
for power supply systems and equipment connected
thereto

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC)

Part 4: Testing and measurement techniques
 Section 7: General guide on harmonics and interharmonics
 measurements and instrumentation, for power supply systems
 and equipment connected thereto

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

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88198e924f/sist-en:61000-4-7-1997

This section of International standard IEC 1000-4 has been prepared by Sub-Committee 77A: Equipment for connection to the public low-voltage supply system, of IEC Technical Committee No. 77: Electromagnetic compatibility between electrical equipment including networks.

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

Six Months' Rule	Report on Voting
77A(CO)32	77A(CO)36

Full information on the voting for the approval of this section can be found in the Voting Report indicated in the above table.

Annex A is for information only.

INTRODUCTION

IEC 1000 is published in separate parts according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)
Definitions, terminology

Part 2: Environment

Description of the environment
Classification of the environment
Compatibility levels

Part 3: Limits

Emission limits
Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques
Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines
Mitigation methods and devices

Part 9: Miscellaneous

Each part is further subdivided into sections which can be published either as International Standards or Technical reports.

These standards and reports will be published in chronological order and numbered accordingly.

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ELECTROMAGNETIC COMPATIBILITY (EMC)

Part 4: Testing and measurement techniques Section 7: General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto

1 Scope

This guide is applicable to instrumentation intended for measuring voltage or current components with frequencies in the range of d.c. to 2 500 Hz which are superimposed on the voltage or current at the power supply frequency.

This guide is also applicable to measurement instrumentation intended for testing individual items of equipment in accordance with emission limits given in standards (e.g. harmonic current limits as given in IEC 555-2) as well as for the measurement of harmonic voltages and currents in actual supply systems. The survey of harmonics in the power supply systems is of particular concern.

The test procedure for measurements and test conditions for emission testing are not dealt with in this guide; these requirements are included in the particular standards.

Harmonics of the supply frequency are of special concern but components at other frequencies (interharmonic components) may also have to be measured.

Frequency-domain and time-domain instrumentation are both considered in this guide.

Tentative recommendations are also given for the statistical analysis of harmonic measurements in the supply in order to make the comparison of results easier.

For fluctuating and rapidly changing harmonics, a distinction is made between the measurement process itself with its relatively small time constant, and the evaluation process which handles the measurement data in a defined manner in order to compare the results with stated limits, acceptance or reference values.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(161): 1990, *International Electrotechnical Vocabulary (IEV), Chapter 161: Electromagnetic compatibility.*

IEC 348: 1978, *Safety requirements for electronic measuring apparatus.*

IEC 555-1: 1982, *Disturbances in supply systems caused by household appliances and similar electrical equipment - Part 1: Definitions:*

IEC 555-2 1982*, *Part 2: Harmonics. Disturbances in supply systems caused by household appliances and similar electrical equipment.*

IEC 801-2: 1984, *Electromagnetic compatibility for industrial-process measurement and control equipment - Part 2: Electrostatic discharge.*

3 Definitions, symbols and indices

3.1 voltage U_m : Component at frequency f_m of the supply voltage.

3.2 current I_m : Component at frequency f_m of the supply current.

NOTE - The expressions U_m (or I_m) and f_m are replaced by U_n (or I_n) and f_n when harmonic quantities of order n related to the power supply frequency are considered.

3.3 definitions related to harmonics: Refer to IEC 50(161) and IEC 555-1.

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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:

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$$f(\omega t) = c_0 + \sum_{n=1}^{\infty} c_n \sin(n\omega_1 t + \varphi_n)$$

$$\underline{c}_n = b_n + ja_n = c_n e^{j\varphi_n}; \varphi_n = \arctan\left(\frac{a_n}{b_n}\right)$$

$$b_n = \frac{1}{\pi} \int_0^{2\pi} f(\omega t) \sin(n\omega_1 t) d(\omega t)$$

$$a_n = \frac{1}{\pi} \int_0^{2\pi} f(\omega t) \cos(n\omega_1 t) d(\omega t)$$

$$c_0 = \frac{1}{2\pi} \int_0^{2\pi} f(\omega t) d(\omega t)$$

where:

ω_1 is the angular frequency of the fundamental ($\omega_1 = 2\pi f_1$);

\underline{c}_n is the complex amplitude of the component with frequency $f_n = nf_1$;

c_0 is the d.c. component.

NOTE - Strictly speaking these definitions apply to steady-state signals only.

* Under revision.