Irish Standard
I.S. EN 61000-4-21:2011

Electromagnetic compatibility (EMC) -- Part 4-21: Testing and measurement techniques - Reverberation chamber test methods (IEC 61000-4-21:2011 (EQV))

I.S. EN 61000-4-21:2011

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S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

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Electromagnetic compatibility (EMC) - Part 4-21: Testing and measurement techniques - Reverberation chamber test methods

(IEC 61000-4-21:2011)

Compatibilité électromagnétique (CEM) - Partie 4-21: Techniques d'essai et de mesure - Méthodes d'essai en chambre réverbérante (CEI 61000-4-21:2011)

Elektromagnetische Verträglichkeit (EMV) - Teil 4-21: Prüf- und Messverfahren - Verfahren für die Prüfung in der Modenverwirbelungskammer (IEC 61000-4-21:2011)

This European Standard was approved by CENELEC on 2011-03-03. 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 Central Secretariat or to any CENELEC member.

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CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 61000-4-21:2011 E

Foreword

The text of document 77B/619/CDV, future edition 2 of IEC 61000-4-21, prepared by SC 77B, High frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61000-4-21 on 2011-03-03.

This European Standard supersedes EN 61000-4-21:2003.

EN 61000-4-21:2011 includes the following significant technical changes with respect to EN 61000-4-21:2003:

• In Clause 8, the use and specifications of E-field probes for application to reverberation chambers has been added. Additional Notes refer to general aspects and procedures of probe calibrations. The specified range for linearity of the probe response is larger and covers an asymmetric interval compared to that for use in anechoic chambers (see Annex I of EN 61000-4-3), because

– the fluctuations of power and fields in reverberation chambers exhibit a larger dynamic range, and

– the chamber validation procedure is based on using maximum field values, as opposed to the field itself or its average value, respectively.

• In Annex A, additional guidance and clarifications on the use of reverberation chambers at relatively low frequencies of operation (i.e., close to the lowest usable frequency of a given chamber) are given, and its implications on the estimation of field uncertainty are outlined. Guidelines on cable-layout have been added. A rationale has been added that explains the relaxation of the field uniformity requirement below 400 MHz, being a compromise between scientific-technical and economical reasons when using chambers around 100 MHz. A first-order correction for the threshold value of the correlation coefficient at relatively low numbers of tuner positions has been added. Issues regarding the use of non-equidistant tuner positions at low frequencies are discussed in an additional note.

• In Annex B, symmetric location of the field probes when the chamber exhibits cylindrical symmetry has been disallowed, as such placement could otherwise yield a false indication of field uniformity and chamber performance at different locations. The difference between start frequency for chamber validation and lowest test frequency has been clarified. The tuner sequencing for chamber validation and testing is now specified to be equal in both cases. In sample requirements for chamber validation, emphasis is now on the required minimum number of independent tuner steps to be used, whereas the minimum recommended number of samples per frequency interval has been replaced with he number of independent samples that the tuner can provide per frequency, for use in case when the chamber validation fails for the required minimum number.

• Annex C now contains more quantitative guidance on the setting of the maximum permissible stirring speeds that warrant quasi-static conditions of operation for chamber validation and testing. Consideration is given to all characteristic time scales of all components or subsystems of a measurement or test. Specific issues relating to chamber validation, immunity testing and bandwidth are addressed. Particular requirements for field probes when used with mode stirred operation are listed.

• In Annex D, a requirement for the EUT and equipment not to occupy more than 8 % of the total chamber volume in immunity testing has been added. The maximum number of frequency points and the formula to calculate these points have been generalized. A mandatory specification for including the measurement equipment, test plan and cable layout in the test report has been added to resolve any dispute in case of discrepancies, particularly for low-frequency immunity testing.

• Annex E has been extended with further guidance on the value of EUT directivity to be used in the estimation of radiated power and field. Extended estimates have been added for the maximum directivity of electrically large, anisotropically radiating EUTs and for radiated emissions in the presence of a ground plane. A mandatory specification for including the measurement equipment, test plan and cable layout in the test report has been added to resolve any dispute in case of discrepancies, particularly for low-frequency emissions testing.

• In Annex I, some clarifications on antenna efficiency measurements have been added.

• A new Annex K has been added that covers measurement uncertainty in reverberation chambers. The intrinsic field uncertainty for chamber validation, immunity and emissions measurements is quantified. Other contributors to measurement uncertainty are listed.

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

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)	2011-12-03
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-03-03

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61000-4-21:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61000-4-6	NOTE	Harmonized as EN 61000-4-6.
CISPR 16-1-2	NOTE	Harmonized as EN 55016-1-2
CISPR 16-1-3	NOTE	Harmonized as EN 55016-1-3.
CISPR 16-1-4	NOTE	Harmonized as EN 55016-1-4.
CISPR 16-1-5	NOTE	Harmonized as EN 55016-1-5.
CISPR 16-2-1	NOTE	Harmonized as EN 55016-2-1.
CISPR 16-2-2	NOTE	Harmonized as EN 55016-2-2.
CISPR 16-2-4	NOTE	Harmonized as EN 55016-2-4.
CISPR 16-2-5	NOTE	Harmonized as EN 55016-2-5.
CISPR 22	NOTE	Harmonized as EN 55022.

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 60050-161 + A1 + A2	1990 1997 1998	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
IEC 60068-1	-	Environmental testing - Part 1: General and guidance	EN 60068-1	-
IEC 61000-4-3 + A1	2006 2007	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3 + A1	2006 2008
CISPR 16-1-1	-	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus	EN 55016-1-1	2010
CISPR 16-2-3	-	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements	EN 55016-2-3	2010

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-21: Testing and measurement techniques – Reverberation chamber test methods

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.
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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 61000-4-21 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility, in co-operation with CISPR subcommittee A: Radio-interference measurements and statistical methods.

It forms Part 4-21 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the first edition.

- In Clause 8, the use and specifications of *E*-field probes for application to reverberation chambers has been added. Additional Notes refer to general aspects and procedures of

probe calibrations. The specified range for linearity of the probe response is larger and covers an asymmetric interval compared to that for use in anechoic chambers (see Annex I of IEC 61000-4-3), because

– the fluctuations of power and fields in reverberation chambers exhibit a larger dynamic range, and

– the chamber validation procedure is based on using maximum field values, as opposed to the field itself or its average value,

respectively.

- In Annex A, additional guidance and clarifications on the use of reverberation chambers at relatively low frequencies of operation (i.e., close to the lowest usable frequency of a given chamber) are given, and its implications on the estimation of field uncertainty are outlined. Guidelines on cable-layout have been added. A rationale has been added that explains the relaxation of the field uniformity requirement below 400 MHz, being a compromise between scientific-technical and economical reasons when using chambers around 100 MHz. A first-order correction for the threshold value of the correlation coefficient at relatively low numbers of tuner positions has been added. Issues regarding the use of non-equidistant tuner positions at low frequencies are discussed in an additional Note.
- In Annex B, symmetric location of the field probes when the chamber exhibits cylindrical symmetry has been disallowed, as such placement could otherwise yield a false indication of field uniformity and chamber performance at different locations. The difference between start frequency for chamber validation and lowest test frequency has been clarified. The tuner sequencing for chamber validation and testing is now specified to be equal in both cases. In sample requirements for chamber validation, emphasis is now on the required minimum number of independent tuner steps to be used, whereas the minimum recommended number of samples per frequency interval has been replaced with he number of independent samples that the tuner can provide per frequency, for use in case when the chamber validation fails for the required minimum number.
- Annex C now contains more quantitative guidance on the setting of the maximum permissible stirring speeds that warrant quasi-static conditions of operation for chamber validation and testing. Consideration is given to all characteristic time scales of all components or subsystems of a measurement or test. Specific issues relating to chamber validation, immunity testing and bandwidth are addressed. Particular requirements for field probes when used with mode stirred operation are listed.
- In Annex D, a requirement for the EUT and equipment not to occupy more than 8 % of the total chamber volume in immunity testing has been added. The maximum number of frequency points and the formula to calculate these points have been generalized. A mandatory specification for including the measurement equipment, test plan and cable layout in the test report has been added to resolve any dispute in case of discrepancies, particularly for low-frequency immunity testing.
- Annex E has been extended with further guidance on the value of EUT directivity to be used in the estimation of radiated power and field. Extended estimates have been added for the maximum directivity of electrically large, anisotropically radiating EUTs and for radiated emissions in the presence of a ground plane. A mandatory specification for including the measurement equipment, test plan and cable layout in the test report has been added to resolve any dispute in case of discrepancies, particularly for low-frequency emissions testing.
- In Annex I, some clarifications on antenna efficiency measurements have been added.
- A new Annex K has been added that covers measurement uncertainty in reverberation chambers. The intrinsic field uncertainty for chamber validation, immunity and emissions measurements is quantified. Other contributors to measurement uncertainty are listed.

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

CDV	Report on voting
77B/619/CDV	77B/640/RVC

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.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 61000 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 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as international standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-21: Testing and measurement techniques – Reverberation chamber test methods

1 Scope

This part of IEC 61000 considers tests of immunity and intentional or unintentional emissions for electric and/or electronic equipment and tests of screening effectiveness in reverberation chambers. It establishes the required test procedures for performing such tests. Only radiated phenomena are considered.

The objective of this part is to establish a common reference for using reverberation chambers to evaluate the performance of electric and electronic equipment when subjected to radio-frequency electromagnetic fields and for determining the levels of radio-frequency radiation emitted from electric and electronic equipment.

NOTE Test methods are defined in this part for measuring the effect of electromagnetic radiation on equipment and the electromagnetic emissions from equipment concerned. The simulation and measurement of electromagnetic radiation is not adequate for quantitative determination of effects. The defined test methods are organized with the aim to establish adequate reproducibility and repeatability of test results and qualitative analysis of effects.

This part of IEC 61000 does not intend to specify the tests to be applied to a particular apparatus or system. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees should select emission limits and test methods in consultation with CISPR. The product committees remain responsible for the appropriate choice of the immunity tests and the immunity test limits to be applied to their equipment. Other methods, such as those covered in IEC 61000-4-3, CISPR 16-2-3 and CISPR 16-2-4 may be used.[1]

2 Normative references

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.

IEC 60050(161):1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

Amendment 1 (1997)

Amendment 2 (1998)

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

Amendment 1 (2007)

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[1] For further information consult with CISPR (International Special Committee on Radio Interference) or Technical Committee 77 (Electromagnetic compatibility).