

© Copyright SEK. Reproduction in any form without permission is prohibited.

## Elektromagnetisk kompatibilitet (EMC) – Del 4-10: Mät- och provningsmetoder – Provning av immunitet mot dämpade magnetiska fält

*Electromagnetic compatibility (EMC) –  
Part 4-10: Testing and measurement techniques –  
Damped oscillatory magnetic field immunity test*

Som svensk standard gäller europastandarden EN 61000-4-10:2017. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61000-4-10:2017.

### Nationellt förord

Europastandarden EN 61000-4-10:2017

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61000-4-10, Second edition, 2016 - Electromagnetic compatibility (EMC) - Part 4-10: Testing and measurement techniques - Damped oscillatory magnetic field immunity test**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61000-4-10, utgåva 1, 1994 och SS-EN 61000-4-10/A1, utgåva 1, 2001, gäller ej fr o m 2020-02-24.

---

ICS 33.100.20

---

Denna standard är fastställd av SEK Svensk Elstandard, som också kan lämna upplysningar om **sakinnehållet** i standarden.  
Postadress: Box 1284, 164 29 KISTA  
Telefon: 08 - 444 14 00.  
E-post: sek@elstandard.se. Internet: www.elstandard.se

---

### *Standarder underlättar utvecklingen och höjer elsäkerheten*

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

### *SEK är Sveriges röst i standardiseringsarbetet inom elområdet*

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

### *Stora delar av arbetet sker internationellt*

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

### *Var med och påverka!*

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

### **SEK Svensk Elstandard**

Box 1284  
164 29 Kista  
Tel 08-444 14 00  
[www.elstandard.se](http://www.elstandard.se)

English Version

Electromagnetic compatibility (EMC) -  
Part 4-10: Testing and measurement techniques - Damped  
oscillatory magnetic field immunity test  
(IEC 61000-4-10:2016)

Compatibilité électromagnétique (CEM) -  
Partie 4-10: Techniques d'essai et de mesure - Essai  
d'immunité du champ magnétique oscillatoire amorti  
(IEC 61000-4-10:2016)

Elektromagnetische Verträglichkeit (EMV) -  
Teil 4-10: Prüf- und Messverfahren - Prüfung der  
Störfestigkeit gegen gedämpft schwingende Magnetfelder  
(IEC 61000-4-10:2016)

This European Standard was approved by CENELEC on 2016-08-11. 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 CEN-CENELEC Management Centre 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 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

## **European foreword**

The text of document 77B/730/CDV, future edition 2 of IEC 61000-4-10, prepared by SC 77B "High frequency phenomena" of IEC/TC 77 "Electromagnetic compatibility" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61000-4-10:2017.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-08-24
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2020-02-24

This document supersedes EN 61000-4-10:1993.

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

## **Endorsement notice**

The text of the International Standard IEC 61000-4-10:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61000-4-18      NOTE      Harmonized as EN 61000-4-18.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	Series	International Electrotechnical Vocabulary (IEV)	-	-

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope and object.....	8
2 Normative references.....	8
3 Terms, definitions and abbreviated terms.....	9
3.1 Terms and definitions.....	9
3.2 Abbreviations.....	10
4 General.....	10
5 Test levels.....	10
6 Test instrumentation.....	11
6.1 General.....	11
6.2 Damped oscillatory wave generator.....	11
6.2.1 General.....	11
6.2.2 Performance characteristics of the generator connected to the standard induction coil.....	12
6.3 Standard induction coil.....	14
6.4 Calibration of the test system.....	14
7 Test setup.....	15
7.1 Test equipment.....	15
7.2 Verification of the test instrumentation.....	15
7.3 Test setup for table-top EUT.....	16
7.4 Test setup for floor standing EUT.....	16
7.5 Test setup for damped oscillatory field applied in-situ.....	18
8 Test procedure.....	18
8.1 General.....	18
8.2 Laboratory reference conditions.....	18
8.2.1 Climatic conditions.....	18
8.2.2 Electromagnetic conditions.....	18
8.3 Execution of the test.....	19
9 Evaluation of test results.....	19
10 Test report.....	20
Annex A (informative) Information on the field distribution of standard induction coils.....	21
A.1 General.....	21
A.2 Determination of the coil factor.....	21
A.2.1 General.....	21
A.2.2 Coil factor calculation.....	21
A.3 1 m × 1 m standard induction coil.....	22
A.4 1 m × 2,6 m standard induction coil with reference ground plane.....	23
A.5 1 m × 2,6 m standard induction coil without reference ground plane.....	24
Annex B (informative) Selection of the test levels.....	26
Annex C (informative) Damped oscillatory magnetic field frequency.....	28
Annex D (informative) Measurement uncertainty (MU) considerations.....	29
D.1 General.....	29
D.2 Legend.....	29

D.3	Uncertainty contributors to the peak current and to the damped oscillatory magnetic field measurement uncertainty .....	29
D.4	Uncertainty of peak current and damped oscillatory magnetic field calibration .....	30
D.4.1	General.....	30
D.4.2	Peak current .....	30
D.4.3	Further MU contributions to amplitude and time measurements .....	32
D.4.4	Rise time of the step response and bandwidth of the frequency response of the measuring system .....	32
D.4.5	Impulse peak distortion due to the limited bandwidth of the measuring system.....	33
D.5	Application of uncertainties in the damped oscillatory wave generator compliance criterion .....	34
Annex E (informative)	3D numerical simulations .....	35
E.1	General.....	35
E.2	Simulations .....	35
E.3	Comments .....	35
Bibliography	.....	41
Figure 1	– Simplified schematic circuit of the test generator for damped oscillatory magnetic field .....	12
Figure 2	– Waveform of short-circuit current in the standard coils .....	13
Figure 3	– Waveform of short-circuit current showing the repetition time $T_{rep}$ .....	13
Figure 4	– Example of a current measurement of standard induction coils.....	14
Figure 5	– Example of test setup for table-top equipment.....	16
Figure 6	– Example of test setup for floor standing equipment showing the horizontal orthogonal plane.....	17
Figure 7	– Example of test setup for floor standing equipment showing the vertical orthogonal plane.....	17
Figure 8	– Example of test setup using the proximity method .....	18
Figure A.1	– Rectangular induction coil with sides $a + b$ and $c$ .....	22
Figure A.2	– +3 dB isoline for the magnetic field strength (magnitude) in the $x$ - $y$ plane for the 1 m × 1 m induction coil .....	22
Figure A.3	– +3 dB and –3 dB isolines for the magnetic field strength (magnitude) in the $x$ - $z$ plane for the 1 m × 1 m induction coil .....	23
Figure A.4	– +3 dB isoline for the magnetic field strength (magnitude) in the $x$ - $z$ plane for the 1 m × 2,6 m induction coil with reference ground plane .....	23
Figure A.5	– +3 dB and –3 dB isolines for the magnetic field strength (magnitude) in the $x$ - $y$ plane for the 1 m × 2,6 m induction coil with reference ground plane .....	24
Figure A.6	– +3 dB isoline for the magnetic field strength (magnitude) in the $x$ - $y$ plane for the 1 m × 2,6 m induction coil without reference ground plane .....	24
Figure A.7	– +3 dB and –3 dB isolines for the magnetic field strength (magnitude) in the $x$ - $z$ plane for the 1 m × 2,6 m induction coil without reference ground plane .....	25
Figure E.1	– Current with period of 1 $\mu$ s and H-field in the center of the 1 m × 1 m standard induction coil .....	36
Figure E.2	– $H_x$ -field along the side of 1 m × 1 m standard induction coil in A/m .....	36
Figure E.3	– $H_x$ -field in direction $x$ perpendicular to the plane of the 1 m × 1 m standard induction coil .....	37
Figure E.4	– $H_x$ -field along the side in dB for 1 m × 1 m standard induction coil .....	37

Figure E.5 – $H_x$ -field along the diagonal in dB for the 1 m × 1 m standard induction coil.....	38
Figure E.6 – $H_x$ -field plot on $y$ - $z$ plane for the 1 m × 1 m standard induction coil.....	38
Figure E.7 – $H_x$ -field plot on $x$ - $y$ plane for the 1 m × 1 m standard induction coil .....	39
Figure E.8 – $H_x$ -field along the vertical middle line in dB for the 1 m × 2,6 m standard induction coil .....	39
Figure E.9 – $H_x$ -field 2D-plot on $y$ - $z$ plane for the 1 m × 2,6 m standard induction coil.....	40
Figure E.10 – $H_x$ -field 2D-plot on $x$ - $y$ plane at $z = 0,5$ m for the 1 m × 2,6 m standard induction coil .....	40
Table 1 – Test levels.....	11
Table 2 – Peak current specifications of the test system .....	15
Table 3 – Waveform specifications of the test system .....	15
Table D.1 – Example of uncertainty budget for the peak of the damped oscillatory current impulse ( $I_p$ ) .....	31
Table D.2 – $\alpha$ factor (see equation (D.6)) of different unidirectional impulse responses corresponding to the same bandwidth of the system $B$ .....	33
Table D.3 – $\beta$ factor (equation (D.12)) of the damped oscillatory waveform.....	34

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROMAGNETIC COMPATIBILITY (EMC) –****Part 4-10: Testing and measurement techniques –  
Damped oscillatory magnetic field immunity test**

## 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 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 61000-4-10 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms Part 4-10 of the IEC 61000 series. 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 1993 and Amendment 1:2000. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) new Annex A on induction coil field distribution;
- b) new Annex D on measurement uncertainty;

- c) new Annex E for numerical simulations;
- d) calibration using current measurement has been addressed in this edition.

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

CDV	Report on voting
77B/730/CDV	77B/746A/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.

A list of all parts in the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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 (insofar 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).

This part is an international standard which gives immunity requirements and test procedures related to "damped oscillatory magnetic field".

## ELECTROMAGNETIC COMPATIBILITY (EMC) –

### Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test

#### 1 Scope and object

This part of IEC 61000 specifies the immunity requirements, test methods, and range of recommended test levels for equipment subjected to damped oscillatory magnetic disturbances related to medium voltage and high voltage sub-stations.

The test defined in this standard is applied to equipment which is intended to be installed in locations where the phenomenon as specified in Clause 4 will be encountered.

This standard does not specify disturbances due to capacitive or inductive coupling in cables or other parts of the field installation. IEC 61000-4-18, which deals with conducted disturbances, covers these aspects.

The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment for medium voltage and high voltage sub-stations when subjected to damped oscillatory magnetic fields.

The test is mainly applicable to electronic equipment to be installed in H.V. sub-stations. Power plants, switchgear installations, smart grid systems may also be applicable to this standard and may be considered by product committees.

NOTE As described in IEC Guide 107, this is a basic EMC publication for use by product committees of the IEC. As also stated in Guide 107, the IEC product committees are responsible for determining whether this immunity test standard is applied or not, and if applied, they are responsible for determining the appropriate test levels and performance criteria. TC 77 and its sub-committees are prepared to co-operate with product committees in the evaluation of the value of particular immunity test levels for their products.

This standard defines:

- a range of test levels;
- test equipment;
- test setups;
- test procedures.

#### 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.

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at [www.electropedia.org](http://www.electropedia.org))