

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

## **Elektromagnetisk kompatibilitet (EMC) – Del 4-31: Mät- och provningsmetoder – Provning av immunitet mot ledningsbundna bredbandiga störningar på elnät**

*Electromagnetic compatibility (EMC) –  
Part 4-31: Testing and measurement techniques –  
AC mains ports broadband conducted disturbance immunity test*

Som svensk standard gäller europastandarden EN 61000-4-31:2017. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61000-4-31:2017.

### **Nationellt förord**

Europastandarden EN 61000-4-31:2017

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61000-4-31, First edition, 2016 - Electromagnetic compatibility (EMC) - Part 4-31: Testing and measurement techniques - AC mains ports broadband conducted disturbance immunity test**

utarbetad inom International Electrotechnical Commission, IEC.

### *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 4-31: Testing and measurement techniques - AC mains  
ports broadband conducted disturbance immunity test  
(IEC 61000-4-31:2016)**

Compatibilité électromagnétique (CEM) -  
Partie 4-31: Techniques d'essai et de mesure - Essai  
d'immunité aux perturbations conduites à large bande sur  
les accès d'alimentation secteur en courant alternatif  
(IEC 61000-4-31:2016)

Elektromagnetische Verträglichkeit (EMV) -  
Teil 4-31: Prüf- und Messverfahren - Prüfung der  
Störfestigkeit gegen leitungsgeführte breitbandige  
Störgrößen an Wechselstrom-Netzanschlüssen  
(IEC 61000-4-31:2016)

This European Standard was approved by CENELEC on 2016-09-01. 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/758/FDIS, future edition 1 of IEC 61000-4-31, 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 61000-4-31:2017.

The following dates are fixed:

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document have to be withdrawn

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 61000-4-31:2016 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:

CISPR 16-1-2      NOTE      Harmonized as EN 55016-1-2.

## 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 60050-161	-	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
IEC 61000-4-6	2013	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	2014

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope and object.....	8
2 Normative references.....	8
3 Terms and definitions .....	8
4 General .....	10
5 Test levels.....	11
6 Test equipment and level setting procedures.....	13
6.1 Test generator .....	13
6.2 Coupling and decoupling devices.....	14
6.2.1 General .....	14
6.2.2 CDND for the port under test.....	15
6.2.3 Coupling/decoupling networks (CDNs) for cables that are not under test .....	15
6.3 Verification of the test systems .....	17
6.3.1 General .....	17
6.3.2 Verification procedure of test generator flatness .....	17
6.3.3 Verification procedure of the insertion loss of the CDND using transformer jigs.....	18
6.3.4 Insertion loss of the injection coupling system .....	20
6.4 Test level setting procedure .....	21
6.4.1 General .....	21
6.4.2 Setting of the output level at the EUT port of the CDND .....	21
7 Test set-up and injection methods.....	22
7.1 Test set-up.....	22
7.2 EUT comprised of a single unit .....	22
7.3 EUT comprised of several units .....	23
7.4 CDN and CDND termination application.....	25
8 Test procedure .....	26
9 Evaluation of the test results.....	27
10 Test report.....	27
Annex A (informative) Measurement uncertainty of the power spectral density test level .....	29
A.1 General.....	29
A.2 Uncertainty budgets for test methods.....	29
A.2.1 General symbols .....	29
A.2.2 Definition of the measurand.....	29
A.2.3 MU contributors of the measurand .....	29
A.2.4 Input quantities and calculation examples for expanded uncertainty .....	30
A.3 Expression of the calculated measurement uncertainty and its application.....	31
Annex B (informative) Rationale for the selection of the preferred broadband source – Information on test signal generation.....	33
B.1 General.....	33
B.2 Principles of band-limited broadband signal generation .....	33
B.2.1 General .....	33
B.2.2 (True) random noise generation.....	33

B.2.3	Pseudo-random noise sequence.....	34
B.2.4	Impulse.....	38
B.2.5	OFDM scheme .....	40
B.3	Selection of the preferred broadband source.....	42
Bibliography	.....	43
Figure 1	– Immunity test to broadband conducted disturbances .....	11
Figure 2	– Example of voltage spectrum of a broadband test signal measured with a 120 kHz resolution bandwidth .....	13
Figure 3	– Principle of the test generator .....	14
Figure 4	– Example of simplified diagram for the circuit of CDND .....	15
Figure 5	– Example of coupling and decoupling network for power ports other than AC mains .....	16
Figure 6	– Test set-up regarding test generator flatness and typical test signal .....	18
Figure 7	– Typical circuit diagram of the transformer jig showing 50 $\Omega$ side and 100 $\Omega$ side of the transformer and 2 pcs 0,1 $\mu$ F coupling capacitors .....	18
Figure 8	– Transformer jig specifications .....	20
Figure 9	– Example of the set-up geometry to verify the insertion loss of the injection coupling system.....	20
Figure 10	– Set-up for the evaluation of the total insertion loss of the injection coupling system.....	21
Figure 11	– Set-up for level setting.....	22
Figure 12	– Example of test set-up for an EUT comprised of a single unit (top view).....	23
Figure 13	– Example of a test set-up for an EUT comprised of several units (top view).....	24
Figure 14	– Immunity test to a 2-port EUT (when only CDNDs can be used).....	26
Figure A.1	– Example of influences upon the power spectral density test level using a CDND.....	30
Figure B.1	– White noise source.....	34
Figure B.2	– Principle of band-limited broadband signal generation with an arbitrary waveform generator .....	35
Figure B.3	– Signal spectrum of a band-limited pseudo-random noise signal (measured with a 120 kHz resolution bandwidth) .....	36
Figure B.4	– Extract of the band-limited pseudo noise signal in time domain (measured with an oscilloscope).....	37
Figure B.5	– Signal spectrum of the band-limited pseudo noise signal without an anti-alias filter .....	37
Figure B.6	– Extract of the signal spectrum of a band-limited pseudo noise signal (measured with a 200 Hz resolution bandwidth).....	38
Figure B.7	– Signal spectrum of a band-limited impulse signal (measured with a 120 kHz resolution bandwidth) .....	39
Figure B.8	– Extract of the band-limited impulse signal in time domain (measured with an oscilloscope).....	39
Figure B.9	– Extract of the signal spectrum of a band-limited impulse signal (measured with a 200 Hz resolution bandwidth).....	40
Figure B.10	– Signal spectrum of an OFDM signal (measured with a 120 kHz resolution bandwidth).....	41
Figure B.11	– Extract of the signal spectrum of an OFDM signal (measured with a 200 Hz resolution bandwidth).....	41

Figure B.12 – Signal spectrum of an OFDM signal with an amplitude step at 30 MHz  
(measured with a 120 kHz resolution bandwidth) .....42

Table 1 – Test levels.....12

Table 2 – Characteristics of the test generator.....14

Table 3 – Specification of the main parameters of the CDND for current  $\leq 16$  A.....15

Table 4 – Usage of CDNs.....16

Table A.1 – CDND level setting process .....31

Table B.1 – Comparison of white noise signal generation methods.....42



## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROMAGNETIC COMPATIBILITY (EMC) –****Part 4-31: Testing and measurement techniques –  
AC mains ports broadband conducted disturbance 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 61000-4-31 has been prepared by subcommittee 77B: High-frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This standard forms Part 4-31 of the IEC 61000 series. It has the status of a basic EMC publication in accordance with IEC Guide 107.

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

FDIS	Report on voting
77B/758/FDIS	77B/760/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.

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 (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).

This part is an International Standard which gives immunity requirements and test procedure related to conducted broadband disturbances.

## **ELECTROMAGNETIC COMPATIBILITY (EMC) –**

### **Part 4-31: Testing and measurement techniques – AC mains ports broadband conducted disturbance immunity test**

#### **1 Scope and object**

This part of IEC 61000 relates to the conducted immunity of electrical and electronic equipment to electromagnetic disturbances coming from intended and/or unintended broadband signal sources in the frequency range 150 kHz up to 80 MHz.

The object of this standard is to establish a common reference to evaluate the immunity of electrical and electronic equipment when subjected to conducted disturbances caused by intended and/or unintended broadband signal sources on AC mains ports. The test method documented in this standard describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon.

Equipment not having at least one AC mains port is excluded. The power ports not intended to be connected to AC mains distribution networks are not considered as “AC mains ports” and therefore are excluded.

This standard is applicable only to single phase equipment having rated input current  $\leq 16$  A; the application of the broadband disturbance to multiple phase equipment and/or equipment with rated input current  $> 16$  A is under consideration.

NOTE As described in IEC Guide 107, this standard 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 to be 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 tests for their products.

#### **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 60050-161, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility* (available at [www.electropedia.org](http://www.electropedia.org))

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*