IEC 61000-4-31

Edition 1.0 2016-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

BASIC EMC PUBLICATION

PUBLICATION FONDAMENTALE EN CEM

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

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 61000-4-31:2016-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

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

FOREWORD

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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- withdrawn,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 ≤ 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*)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 as well as the following apply.

3.1
artificial hand
electrical network simulating the impedance of the human body under average operational conditions between a hand-held electrical appliance and earth

Note 1 to entry: The construction should be in accordance with CISPR 16-1-2.

[SOURCE: IEC 60050-161:1990, 161-04-27, modified – A note to entry has been added.]

3.2
auxiliary equipment
AE
equipment necessary to provide the equipment under test (EUT) with the signals required for normal operation and equipment to verify the performance of the EUT

3.3
common mode impedance
asymmetrical mode impedance between a cable attached to a port and the reference ground plane (RGP)

Note 1 to entry: This note applies to the French language only.

3.4
coupling network
electrical circuit for transferring energy from one circuit to another with a defined impedance

Note 1 to entry: Coupling and decoupling devices can be integrated into one box (coupling/decoupling network (CDN)) or they can be in separate networks.

3.5
coupling/decoupling network
CDN
electrical circuit incorporating the functions of both the coupling and decoupling networks

3.6
coupling/decoupling network for differential mode coupling
CDND
electrical circuit incorporating the functions of both the coupling and decoupling networks that injects the signal primarily in differential mode

3.7
decoupling network
decoupling device
electrical circuit for preventing test signals applied to the EUT from affecting other devices, equipment or systems that are not under test

3.8
differential mode impedance
symmetrical mode impedance between L and N of an AC mains port

3.9
longitudinal conversion loss
LCL
measure, in a one- or two-port network, of the degree of unwanted transverse (symmetric mode) signal produced at the terminals of the network due to the presence of a longitudinal (asymmetric mode) signal on the connecting leads

Note 1 to entry: LCL is a ratio expressed in dB.

[SOURCE: ITU-T O.9:1999, 4.1, modified – The definition has been rephrased and the parentheses have been added.]

3.10
orthogonal frequency-division multiplexing
OFDM
digital multi-carrier modulation scheme, which uses a large number of closely-spaced orthogonal sub-carriers

Note 1 to entry: See ITU-R BT.1306-7:2015.

Note 2 to entry: This note applies to the French language only.

3.11
test generator
generator capable of generating the required test signal

Note 1 to entry: The generator may include the following: white noise source, modulation source, attenuators, broadband power amplifier and filters.

Note 2 to entry: See Figure 3.

3.12
voltage standing wave ratio
VSWR
ratio of a maximum to an adjacent minimum voltage magnitude along the line

4 General

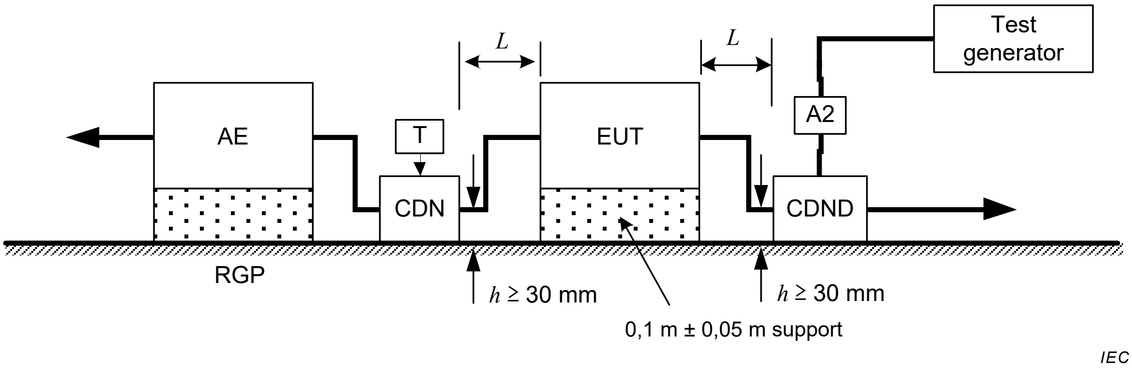
The source of disturbance covered by this standard is basically an intended and/or unintended conducted broadband disturbance superimposed on the mains line to the AC mains port of the EUT.

For example, the signals generated by PLT systems are intentionally-generated broadband disturbances, whereas other electrical and electronic equipment connected to the AC mains network may emit unintentional broadband disturbances.

NOTE Power line telecommunications (PLT) is also known as broadband power line (BPL) and as power line communication (PLC).

Even when the broadband signal is intended to be differential, the unbalance of the mains converts part of it into a common mode signal. To take this phenomenon into account, the disturbance signal is injected through a coupling/decoupling network for differential mode coupling (CDND) having a longitudinal conversion loss (LCL) similar to a typical mains distribution network (see Figure 1).

The characteristics of the CDND are given in 6.2.



Key

A2 optional power attenuator

L 0,1 m $\leq L \leq$ 0,3 m

T termination 50 Ω

CDND coupling and decoupling network for injection of the test signal primarily in differential mode

CDN coupling and decoupling network as prescribed in IEC 61000-4-6

Figure 1 – Immunity test to broadband conducted disturbances

With the EUT connected to the CDND, a power attenuator (A2 in Figure 1) of 3 dB or larger shall be inserted between the test generator and the CDND, unless it can be shown that the voltage standing wave ratio (VSWR) due to the mismatch between the test generator and the CDND is ≤ 2.

5 Test levels

The level of the broadband test signal to be applied to the AC power ports under test over the selected frequency range of interest is defined by its power spectral density (PSD) expressed in dBm/Hz and shall be selected from column 2 of Table 1.

For convenience, the test levels are also given for the whole frequency range from 150 kHz to 80 MHz in equivalent voltage spectrum expressed in dB (μV)/100 kHz (see column 3 of Table 1), and in total forward power expressed in dBm (see column 4 of Table 1).

These values were derived in a 50 Ω system using Formula (1) and need to be recalculated if a different or reduced frequency range is selected for the test.

For more details regarding the verification of test levels see also Figure 11.

Table 1 – Test levels

Frequency range 150 kHz to 80 MHz			
Level	**Power spectral density** dBm/Hz	**Equivalent voltage spectrum density** dB (μV)/100 kHz	**Total forward power** dBm
1	–60	97	19
2	–50	107	29
3	–40	117	39
x[a]	Special	Special	Special

NOTE The requirements are in column 2; columns 3 and 4 are added for convenience.

[a] "*x*" can be any level, above, below or in between the others. The level has to be specified in the dedicated equipment specification.

An example of a broadband test signal is shown in Figure 2.

In particular cases of intentional broadband disturbances, product committees may specify a suitable limited frequency range for testing the EUT.

The total forward power for a given power spectral density and selected frequency range can be calculated using Formula (1).

$$P_{TF} = P_{SD} + 10\log\left(\frac{f_{stop} - f_{start}}{1\ \text{Hz}}\right) \quad (1)$$

where

P_{TF} is the total forward power, in dBm;

P_{SD} is the power spectral density, in dBm/Hz;

f_{stop} is the upper frequency of the test frequency band, in Hz; and

f_{start} is the lower frequency of the test frequency band, in Hz.

The setting procedure of the test levels at the EUT port of the coupling device (CDND) is described in 6.4.

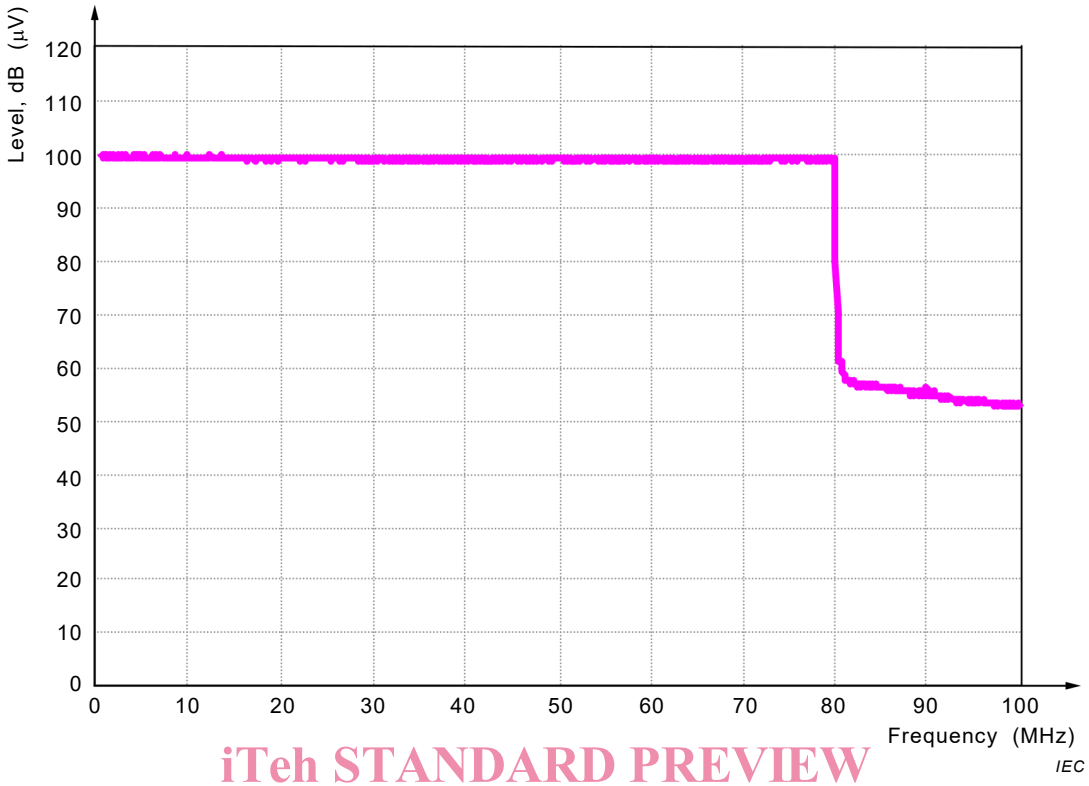


Figure 2 – Example of voltage spectrum of a broadband test signal measured with a 120 kHz resolution bandwidth

6 Test equipment and level setting procedures

6.1 Test generator

The test generator (see Figure 3) includes all the necessary equipment and to provide a broadband input to the CDND that causes the required test signal to be applied to the EUT with the required level, frequency range, modulation, etc.

A typical arrangement comprises the following items which may be separate or integrated into one or more test instruments:

- a white noise source, G1, capable of generating a broadband signal over the frequency band of interest. The parameters can be set by manual control or programmable control (e.g. frequency band, amplitude). For more details, see Annex B.
- a pulse modulation capability of 1 Hz and 2 Hz (50 % duty cycle);
- a variable attenuator, A1, (typically from 0 dB to 40 dB) to control the output level of the generated disturbing source, and which is optional;
- an RF switch, S1, by which the disturbing broadband signal can be switched on and off when evaluating the immunity of the EUT. S1 may be included in G1 and is optional;
- a broadband power amplifier, PA, which may be necessary to amplify the signal if the output power of the G1 is insufficient;
- a low-pass filter (LPF), and/or a high-pass filter (HPF), which may be necessary to avoid interference caused by (higher order or sub-) harmonics with some types of EUT, for example RF receivers. When required, they shall be inserted between the output of the broadband power amplifier, PA, and the coupling device (CDND).

The characteristics of the test generator are given in Table 2.