IEC 61000-2-4

Edition 3.0 2024-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Electromagnetic compatibility (EMC) –
Part 2-4: Environment – Compatibility levels in power distribution systems in industrial locations for low-frequency conducted disturbances

Compatibilité électromagnétique (CEM) –
Partie 2-4: Environnement – Niveaux de compatibilité dans les réseaux de distribution d'électricité sur des sites industriels pour les perturbations conduites à basse fréquence

IEC 61000-2-4:2024-07(en-fr)

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2-4: Environment – Compatibility levels in power distribution systems in industrial locations for low-frequency conducted disturbances

FOREWORD

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IEC 61000-2-4 has been prepared by subcommittee 77A: EMC – Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility. It is an International Standard.

This third edition cancels and replaces the second edition published in 2002. This edition constitutes a technical revision.

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

a) introduction of new classes 2a, 2b and 2L (former class 2);
b) modification of existing compatibility levels for class 3;
c) addition of compatibility levels in the frequency range 2 kHz to 150 kHz;

d) addition of compatibility levels using a new quantity: partial weighted harmonic distortion (PWHD).

The text of this International Standard is based on the following documents:

Draft	Report on voting
77A/1215/FDIS	77A/1221/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document 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, 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 61000-3-11).

Detailed information on the various types of disturbances that can be expected on public power supply systems can be found in IEC 61000-2-1 and IEC 61000-2-12.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2-4: Environment – Compatibility levels in power distribution systems in industrial locations for low-frequency conducted disturbances

1 Scope

This part of IEC 61000 is related to conducted disturbances in the frequency range from 0 kHz to 150 kHz. It gives compatibility levels in differential mode (L-L and L-N) for industrial locations, with a nominal voltage up to 35 kV and a nominal frequency of 50 Hz or 60 Hz.

NOTE 1 Industrial locations are defined in 3.1.8.

Power distribution systems on ships, aircraft, offshore platforms and railways are not included.

NOTE 2 See also Annex E. The compatibility levels specified in this document apply at the in-plant point of coupling (IPC). The level of the low-frequency disturbances at the terminals of equipment receiving its supply from the IPC is generally assumed to be similar to the disturbance level at the IPC itself. However, in some situations this is not the case, particularly when a long feeder is dedicated to the supply of a particular load, or when a disturbance is generated or amplified within the installation of which the equipment forms a part.

Compatibility levels are specified for the types of low-frequency electromagnetic disturbances expected at any in-plant point of coupling (IPC) within industrial locations, for guidance in the definition of:

a) limits for disturbance emissions in industrial power distribution systems (including the planning levels defined in 3.1.5);

NOTE 3 A very wide range of conditions is possible in the electromagnetic environments of industrial networks. These are approximated in this document by the three classes described in Clause 4. However, it is the responsibility of the operator of such a network to take account of the particular electromagnetic and economic conditions, including equipment characteristics, in setting the above-mentioned limits.

b) immunity levels for the equipment within these systems.

The disturbance phenomena considered are:

- voltage deviations;
- voltage dips and short interruptions;
- voltage imbalance;
- power-frequency variations;
- harmonics up to order 40;
- interharmonics up to the 40^{th} harmonic;
- voltage components above the 40^{th} harmonic up to 150 kHz;
- DC component;
- transient overvoltages.

The compatibility levels are given for different classes of environment determined by the characteristics of the supply network and loads.

NOTE 4 Compatibility levels at the point of common coupling (PCC) on public networks are specified in IEC 61000-2-2 for low-voltage networks and IEC 61000-2-12 for medium-voltage networks. IEC TR 61000-3-6 and IEC TR 61000-3-7 describe the approach of power distribution system operators to the limitation of emissions from installations and large loads.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*
IEC 61000-2-2:2002/AMD1:2017
IEC 61000-2-2:2002/AMD2:2018

IEC 61000-2-12, *Electromagnetic compatibility (EMC) – Part 2-12: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems*

IEC 61000-4-7, *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*

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*

CISPR 16-2-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 General definitions

3.1.1
electromagnetic disturbance
electromagnetic phenomenon that can degrade the performance of a device, equipment or system

[SOURCE: IEC 60050-161:2018, 161-01-05, modified – in the definition the words “or adversely affect living or inert matter” have been deleted and Note 1, Note 2, and Note 3 have been deleted.]

3.1.2
disturbance level
amount or magnitude of an electromagnetic disturbance, measured and evaluated in a specified way

3.1.3
electromagnetic compatibility
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

Note 1 to entry: Electromagnetic compatibility is a condition of the electromagnetic environment such that, for every phenomenon, the disturbance emission level is sufficiently low and immunity levels are sufficiently high so that all devices, equipment and systems operate as intended.

Note 2 to entry: Electromagnetic compatibility is achieved only if emission and immunity levels are controlled such that the immunity level of devices, equipment and systems, at any location, are not exceeded by the disturbance level at that location, resulting from the cumulative emission of all sources and other factors such as circuit impedances. Conventionally, compatibility is said to exist if the probability of the departure from intended performance or of the adverse effect is sufficiently low. See IEC 61000-2-1:1990, Clause 4.

Note 3 to entry: Where the context requires it, compatibility is intended to refer to a single disturbance or class of disturbances.

Note 4 to entry: Electromagnetic compatibility is a term used also to describe the field of study of the adverse electromagnetic effect which devices, equipment and systems undergo from each other or from electromagnetic phenomena.

[SOURCE: IEC 60050-161:2018, 161-01-07, modified – Note 1 to Note 4 have been added.]

3.1.4
(electromagnetic) compatibility level
specified electromagnetic disturbance level used as a reference level in a specified environment for coordination in the setting of emission and immunity limits

Note 1 to entry: By convention, the compatibility level is chosen so that there is only a small probability that it will be exceeded by the actual disturbance level.

[SOURCE: IEC 60050-161:1990, 161-03-10, modified – the last sentence of Note 1 is deleted because it is less relevant in industrial locations compared to public locations.]

3.1.5
planning level
level of a particular disturbance in a particular environment, adopted as a reference value for the limits to be set for the emission of large loads and installations, in order to coordinate those limits with all the limits adopted for equipment intended to be connected to the power supply system

Note 1 to entry: The planning level is locally specific and is adopted by those responsible for planning and operating the power supply network in the relevant area. (For further explanation, see IEC 61000-2-2:2002, Annex A and IEC 61000-1-2.)

3.1.6
industrial and private power distribution system
distribution network that is separated by at least one separation transformer from the public power supply system to which other customer installations are connected

3.1.7
point of common coupling
PCC
point on a public power supply network, electrically nearest to a particular load, at which other loads are, or could be, connected

Note 1 to entry: The PCC is usually the point for which electromagnetic compatibility in public networks is to be considered.

[SOURCE: IEC 60050-161:1990, 161-07-15, modified – the two notes have been deleted, the content of Note 2 is integrated in the definition and a new note has been added.]

3.1.8
industrial location
location characterized by an installation consisting of a separate power distribution network, supplied by a high- or medium-voltage transformer, dedicated for the supply of this installation

Note 1 to entry: Industrial locations can generally be described by the existence of an installation with one or more of the following characteristics:

- significant amount of electrical power generated, transmitted and/or consumed;
- frequent switching of heavy inductive or capacitive loads;
- high currents and associated magnetic fields;
- presence of industrial, high power scientific and medical (ISM) equipment (for example, welding machines).

The electromagnetic environment at an industrial location is predominantly produced by the equipment and installation present at the location. There are types of industrial locations where some of the electromagnetic phenomena appear in a more severe degree than in other installations.

Example locations include metalworking, pulp and paper, chemical plants, car production, farm building, high voltage areas of airports.

Note 2 to entry: The connection between location and electromagnetic environment is given in 3.1.8.

[SOURCE: IEC 61000-6-4:2018, 3.1.12, modified – in the definition, “an installation consisting of” has been added, and the term reference in Note 2 has been updated.]

3.1.9
electromagnetic environment
totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, the electromagnetic environment is time-dependent and its description can be better described with a statistical approach.

Note 2 to entry: It is very important not to confuse the concept of electromagnetic environment with the surrounding location.

[SOURCE: IEC 61000-6-4:2018, 3.1.13.]

3.1.10
in-plant point of coupling
IPC
point inside a non-public power distribution system, electrically nearest to a given load, at which loads from other branches are, or could be, connected

Note 1 to entry: The IPC is usually the point for which electromagnetic compatibility in industrial networks is to be considered.

3.2 Phenomena-related definitions

NOTE 1 The definitions below that relate to harmonics are based on the analysis of system voltages or currents by the discrete Fourier transform method (DFT). This is the practical application of the Fourier transform as defined in IEV 101-13-09. See Annex A.

NOTE 2 The Fourier transform of a function of time, whether periodic or non-periodic, is a function in the frequency domain and is referred to as the frequency spectrum of the time function, or simply spectrum. If the time function is periodic the spectrum is constituted of discrete lines (or components). If the time function is not periodic, the spectrum is a continuous function indicating components at all frequencies.

NOTE 3 Other definitions related to harmonics or interharmonics are given in IEC 60050 (all parts) and other standards. Some of those other definitions, although not used in this document, are discussed in Annex A.

3.2.1
fundamental frequency
frequency, in the spectrum obtained from a Fourier transform of a time function, to which all the components of this spectrum are referred

Note 1 to entry: In the case of a periodic function, the fundamental frequency is generally equal to the frequency of the function itself (see Clause A.1.). For the purposes of this document, the fundamental frequency is also the same as the power supply frequency.

3.2.2
fundamental component
fundamental
spectral component of a periodic time function whose frequency is equal to the fundamental frequency

3.2.3
harmonic frequency
frequency which is an integer multiple of the fundamental frequency

3.2.4
harmonic order
ratio of the harmonic frequency to the fundamental frequency

Note 1 to entry: The recommended notation for harmonic order is "h".

3.2.5
harmonic component
spectral component of a periodic time function whose frequency is a harmonic frequency

Note 1 to entry: Harmonic components are often referred to as harmonics.

Note 2 to entry: See IEC 61000-4-7 for measuring conditions.

3.2.6
interharmonic frequency
any frequency between two consecutive harmonic frequencies

3.2.7
interharmonic order
ratio of an interharmonic frequency to the fundamental frequency

Note 1 to entry: This ratio is not an integer and can be indicated with "m".

3.2.8
interharmonic component
spectral component having an interharmonic frequency

Note 1 to entry: For brevity, such a component can be referred to simply as an interharmonic.