# IEC 61000-2-4

Edition 3.0 2024-07
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside

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



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



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

## FOREWORD

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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61000-2-4:2002. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

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.

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# 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 ~~plants~~ 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 ~~9~~ 150 kHz. It gives ~~numerical~~ compatibility levels in differential mode (L-L and L-N) for industrial locations ~~and non-public power distribution systems~~, 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 ~~supply~~ distribution systems on ships, aircraft, offshore platforms and railways are not included.

~~The compatibility levels specified in this standard apply at the in-plant point of coupling. At the power input terminals of equipment receiving its supply from the above systems, the severity levels of the disturbances can, for the most part, be taken to be the same as the levels at the in-plant point of coupling. In some situations this is not so, particularly in the case of a long feeder dedicated to the supply of a particular load, or in the case of a disturbance generated or amplified within the installation of which the equipment forms a part.~~

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 ~~of the types which can be~~ expected at any in-plant point of coupling (IPC) within industrial ~~plants or other non-public networks~~ locations, for guidance in the definition of:

a) limits for disturbance emissions in industrial power ~~supply~~ 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 ~~and other non-public~~ 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) ~~the choice of~~ immunity levels for the equipment within these systems.

The disturbance phenomena considered are:

– voltage deviations;
– voltage dips and short interruptions;
– voltage ~~unbalance~~ imbalance;
– power-frequency variations;
– harmonics up to order ~~50~~ 40;
– interharmonics up to the ~~50~~ 40$^{th}$ harmonic;
– voltage components ~~at higher frequencies (above 50th harmonic)~~ above the 40$^{th}$ harmonic up to 150 kHz;
– DC component;

– transient overvoltages.

The compatibility levels are given for different classes of ~~the electromagnetic~~ 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 ~~supply authorities~~ 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 60050-101, *International Electrotechnical Vocabulary (IEV) – Part 101: Mathematics*~~

~~IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*~~

~~IEC 60050-551, *International Electrotechnical Vocabulary (IEV) – Part 551: Power electronics*~~

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*~~[1]~~

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 part of IEC 61000, the definitions given in chapter 161 and parts 101 and 551 of IEC 60050 (IEV) as well as the following apply.~~

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



~~[1] To be published.~~

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**
~~any electromagnetic phenomenon which, by being present in the electromagnetic environment, can cause electrical equipment to depart from its intended performance~~

~~[IEV 161-01-05, modified]~~

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

~~[IEV 161-03-01, modified]~~



**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 ~~may be understood~~ 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 ~~on a network inside a system or an installation, electrically nearest to a particular load, at which other loads~~ 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 frequencies of the spectrum are referred~~. For the purposes of this standard, the fundamental frequency is the same as the power supply frequency~~

~~[IEV 101-14-50, modified]~~



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.



~~NOTE 2 In case of any remaining risk of ambiguity, the power supply frequency should be referred to the polarity and speed of rotation of the synchronous generator(s) feeding the system.~~

~~NOTE 3 This definition may be applied to any industrial power supply network, without regard to the load it supplies (a single load or a combination of loads, rotating machines or other loads), and even if the generator feeding the network is a semiconductor converter.~~

**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~~. The ratio of the harmonic frequency to the fundamental frequency is named harmonic order. (Recommended notation "*h*")~~

**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*".