

TECHNICAL REPORT

BASIC EMC PUBLICATION

**Electromagnetic compatibility (EMC) –
Part 5-1: Installation and mitigation guidelines – General considerations**

IEC TR 61000-5-1:2023

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 5-1: Installation and mitigation guidelines –
General considerations**

FOREWORD

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IEC TR 61000-5-1 has been prepared by IEC technical committee 77: Electromagnetic compatibility. It is a Technical Report.

It forms Part 5-1 of IEC 61000. 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 1996. This edition constitutes a technical revision.

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

- a) restructuring of clauses and subclauses with amending of technical content;
- b) alignment of the terminology with other parts of the IEC 61000 series, for example with IEC TR 61000-2-5;
- c) addition of an overview regarding the IEC 61000-5 series in Annex A.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
77/585/DTR	77/588/RVDTR

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

The language used for the development of this Technical Report is English.

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- withdrawn,
- replaced by a revised edition, or
- amended.

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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 parts which are to be published either as international standards or as technical specifications or as 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).

These parts of IEC 61000-5 will be published in chronological order and numbered accordingly.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 5-1: Installation and mitigation guidelines –

General considerations

1 Scope

This part of IEC 61000-5, which is a technical report, covers general considerations and guidelines on mitigation methods aimed at ensuring electromagnetic compatibility (EMC) among electrical and electronic apparatus or systems used in industrial, commercial, and residential installations. This document is intended for use by all using and installing sensitive electrical or electronic installations and systems, and equipment with high emission levels that could degrade the overall electromagnetic (EM) environment. It applies primarily to new installations, but also applies during modifications or enhancements of legacy installations.

Specific topics, such as recommendations on the design and implementation of the earthing system, including the earth electrode and the earth network, the design and implementation of bonding apparatus or systems to earth or to the earth network, the selection and installation of appropriate cables, and the design and implementation mitigation means involving shielded enclosures, high-frequency filters, isolating transformers, surge-protective devices, etc., will be addressed in other parts of IEC 61000-5. Within this document the fundamental measures will be described.

The practices presented in this document address the EMC concerns of the installation, not the safety aspects of the installation nor the efficient transportation of power within the installation. Nevertheless, these two prime objectives are taken into consideration in the technical observations concerning EMC. These two primary objectives can be implemented concurrently for enhanced EMC of the installed sensitive apparatus or systems without conflict by applying the practices presented in this document and the relevant safety requirements. It is the responsibility of the designer and the installer to select the relevant technique most appropriate to a particular installation.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological 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>

3.1.1

bonding

act of connecting together exposed conductive parts and extraneous conductive parts of equipment, systems, or installations that are at essentially the same potential

3.1.2

disturbance level

level of an electromagnetic disturbance existing at a given location, which results from all contributing disturbance sources

[SOURCE: IEC 60050-161:1990, 161-03-29]

3.1.3

reference ground

part of the Earth considered as conductive, the electric potential of which is conventionally taken as zero, being outside the zone of influence of any earthing arrangement

Note 1 to entry: The concept "Earth" means the planet and all its physical matter.

[SOURCE: IEC 60050-195:2021, 195-01-01]

3.1.4

earth, verb

ground, verb US

to make an electric connection between a given point in a system or in an installation or in equipment and a local earth

Note 1 to entry: The connection to local earth can be

- intentional, or
- unintentional or accidental

and can be permanent or temporary.

[SOURCE: IEC 60050-195:2021, 195-01-08, modified – in the definition "a conductive part" has been replaced with "a given point in a system or in an installation or in equipment".]

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3.1.5

earth electrode

ground electrode, US

conductive part, which may be embedded in the soil or in a specific conductive medium, for example concrete or coke, in electric contact with the earth

3.1.6

earthing network

conductors of the earthing system, not in contact with the soil, connecting apparatus, systems, or installations to the earth electrode or to other means of earthing

3.1.7

earthing system

three-dimensional electrical circuit which performs the earthing

Note 1 to entry: The earthing system includes two parts: the earth electrode and the earthing network.

3.1.8

electromagnetic compatibility

EMC

ability of a device, equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:2018, 161-01-07, modified – the term "device" has been added to the definition.]

3.1.9 (electromagnetic) compatibility level

specified electromagnetic disturbance level used as a reference level for co-ordination 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. However, electromagnetic compatibility is achieved only if emission and immunity levels are controlled such that, at each location, the disturbance level resulting from the cumulative emissions is lower than the immunity level for each device, equipment and system situated at this same location.

Note 2 to entry: The compatibility level may be phenomenon, time or location dependent.

[SOURCE: IEC 60050-161:1990, 161-03-10]

3.1.10 facility

building or piece of equipment (like a hospital, factory, machinery, etc.) that is built, constructed, installed or established to perform some particular functions or to serve or facilitate some particular end

3.1.11 low frequency LF

frequency up to and including 9 kHz

[SOURCE: IEC 60050-161:2014, 161-01-26]

3.1.12 high frequency HF

frequency above 9 kHz

[SOURCE: IEC 60050-161:2014, 161-01-25]

3.1.13 immunity margin

ratio of the immunity limit to the electromagnetic compatibility level

[SOURCE: IEC 60050-161:1990, 161-03-16]

3.1.14 immunity level

maximum level of a given electromagnetic disturbance incident on a particular device, equipment or system, for which it remains capable of operating at a required degree of performance

[SOURCE: IEC 60050-161:1990, 161-03-14]

3.1.15 point of common coupling PCC

point of a power supply network, electrically nearest to a particular load, at which other loads are, or may be, connected

Note 1 to entry: These loads can be either devices, equipment or systems, or distinct customer's installations.

Note 2 to entry: In some applications, the term "point of common coupling" is restricted to public networks.

[SOURCE: IEC 60050-161:1990, 161-07-15]

3.1.16**in-plant point of coupling****IPC**

point of coupling inside the system or installation to be studied

3.1.17**port**

particular interface of the specified equipment with the external electromagnetic environment

Note 1 to entry: In some cases different ports can be combined.

3.2 Abbreviated terms

AC alternating current

CB citizen band

CW continuous wave

DC direct current

EM electromagnetic

EMC electromagnetic compatibility

ESD electrostatic discharge

GSM global system for mobile communication

HEMP high altitude electromagnetic pulse

HF high frequency

HPEM high power electromagnetic pulse

IEMI intentional electromagnetic interference

IPC in-plant point of coupling

LEMP lightning electromagnetic pulse

LF low frequency

PCC point of common coupling

PLT power line telecommunications

RF radio frequency

RFID radio-frequency identification

4 Electromagnetic phenomena**4.1 Overview of electromagnetic phenomena**

Any equipment, system or installation that transmits, distributes, processes, or otherwise utilises any form of electrical energy can be source of electromagnetic interference, if any aspect of its operation generates electromagnetic disturbance that results in a degradation of performance of any neighbouring equipment, system, or installation.

The classification of electromagnetic disturbances can be undertaken in several ways. For the purpose of this document, the classification is underpinned by the following:

- the variation of the electromagnetic disturbance signal amplitude as a function of frequency; and
- the propagation means of the disturbance either as conducted or radiated.

The application of the above criteria results in the following categories of electromagnetic disturbances that are considered in EMC work:

- low-frequency conducted phenomena (e.g., harmonics, voltage dips and fluctuations);
- low-frequency radiated phenomena (e.g., magnetic fields at power frequency);
- high-frequency conducted phenomena (e.g., fast transients);
- high-frequency radiated phenomena (e.g., electromagnetic fields);
- electrostatic discharges (ESD).

To ensure EMC, equipment, systems and installations are required to cope with the disturbing effects of electromagnetic phenomena independent of their origin. Table 1 gives an overview of electromagnetic phenomena which can occur at a particular location. These electromagnetic phenomena need to be considered in the design and installation of the equipment or system in order to ensure electromagnetic compatibility.

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