



BSI Standards Publication

Electromagnetic compatibility (EMC)

Part 1-1: General — Application and interpretation
of fundamental definitions and terms

National foreword

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TECHNICAL REPORT



BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) – Part 1-1: General – Application and interpretation of fundamental definitions and terms

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

FOREWORD.....	4
1 Scope.....	7
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Terms and definitions.....	7
3.2 Abbreviated terms.....	10
4 The electromagnetic environment	10
4.1 General.....	10
4.2 Coupling between emitting and susceptible devices	11
5 Application of EMC terms and definitions.....	12
5.1 General.....	12
5.2 Relation between various types of levels.....	12
5.2.1 Emissions and immunity level (and limit).....	12
5.2.2 Compatibility level	13
5.2.3 Examples to illustrate the concepts of using levels and limits.....	14
5.3 Probability aspects and margins	16
5.3.1 Compatibility levels and uncertainties	16
5.3.2 Standardized test.....	17
5.3.3 In situ test – Superposition	18
5.3.4 Lack of data.....	20
6 Models and their limitations	21
6.1 General.....	21
6.2 Source models.....	21
6.2.1 Conducted emissions.....	21
6.2.2 Radiated emissions	22
6.3 Coupling models	23
6.3.1 General	23
6.3.2 Common impedance coupling	23
6.3.3 Coupling by induction	24
6.3.4 Radiative coupling	27
6.4 Susceptible device models.....	27
Annex A (informative) Interpretation of EMC terms and definitions.....	28
A.1 General.....	28
A.2 Units and decibels	28
A.3 Electromagnetic interference, compatibility and environment	29
A.3.1 General	29
A.3.2 Electromagnetic interference (EMI).....	29
A.3.3 Electromagnetic compatibility (EMC)	30
A.3.4 The electromagnetic environment	30
A.4 Susceptibility/immunity.....	31
A.5 Level and limit	31
A.6 Emission and immunity	32
A.7 Compatibility level and margin	34
Annex B (informative) Standardized and in situ tests	37
Annex C (informative) Review of the historical assignment of radiated disturbance degrees	38

C.1	General.....	38
C.2	Theoretical analysis of radiated disturbance degrees	38
C.3	Detailed derivations	40
C.3.1	Derivation of Formula (C.4).....	40
C.3.2	Derivation of Formula (C.5).....	41
	Bibliography.....	43
	Figure 1 – Coupling paths between emitting and susceptible devices.....	11
	Figure 2 – Limits and levels for a single emitter and susceptible device as a function of some independent variable (e.g., frequency).....	13
	Figure 3 – Emission/immunity limits and compatibility levels, with an example of emission/immunity levels for a single emitter and susceptible device as a function of some independent variable (e.g., frequency).....	13
	Figure 4 – Compatibility levels U_C for the odd harmonics in a public low-voltage network and examples of associated emission and immunity limits.....	15
	Figure 5 – Limits, compatibility levels and margins, as a function of any independent variable (e.g., frequency)	17
	Figure 6 – Example of the probability densities for an emission level and an immunity level, at one single value of the independent variable	18
	Figure 7 – Example of superposition of disturbances	20
	Figure 8 – Example of probability densities for an ultimate disturbance level (the sum of disturbance levels produced by various emitters) and the immunity levels of two types of susceptible device	20
	Figure 9 – Source model for conducted emissions (source loaded by Z_{L1} and Z_{L2})	22
	Figure 10 – Electric and magnetic dipole elements.....	23
	Figure 11 – Capacitance per unit length as a function of conductor separation.....	25
	Figure 12 – Flux density from parallel conductors	26
	Figure A.1 – The basic form of an EMI problem	29
	Figure A.2 – Subdivision of EMC in its key aspects	30
	Figure A.3 – Overview of various EMC terms and measuring conditions	34
	Figure A.4 – Examples of probability densities $p(D)$, $p(I)$ and the resulting $p(I - D)$	35
	Figure C.1 – Problem geometry	39
	Table C.1 – Radiated disturbance degrees	38

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 1-1: General – Application and interpretation
of fundamental definitions and terms**

FOREWORD

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

It forms Part 1-1 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 1992. This edition constitutes a technical revision.

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

- a) the general description of the electromagnetic environment has been updated in accordance with IEC TR 61000-2-5;
- b) the description of source, of potentially susceptible equipment/systems and of coupling mechanism has been updated,

- c) elements from IEC TR 61000-2-3, that is intended to be withdrawn, as well as from IEC TR 61000-2-5, have been incorporated into this document.

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

Draft	Report on voting
77/586/DTR	77/587/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.

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 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).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-1: General – Application and interpretation of fundamental definitions and terms

1 Scope

This part of IEC 61000, which is a Technical Report, aims to describe and interpret various terms considered to be of basic importance to concepts and practical application in the design and evaluation of electromagnetically compatible equipment and systems.

In addition, attention is drawn to the distinction between electromagnetic compatibility (EMC) tests carried out in a standardized set-up and those carried out at other locations, for example at premises where a device, equipment or system is manufactured or at the location where a device, equipment or system is installed (in situ tests or measurements).

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 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility* (available at www.electropedia.org)

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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

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

3.1.1

(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]

3.1.2

(electromagnetic) compatibility margin

ratio of the immunity limit to the emission limit

Note 1 to entry: The compatibility margin is the product of the emission margin and the immunity margin

Note 2 to entry: If the levels are expressed in dB(...), in the above margin definitions "difference" is used instead of "ratio" and "sum" instead of "product".

[SOURCE: IEC 60050-161:1990, 161-03-17, modified – note 2 has been added.]

3.1.3

electromagnetic environment

totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, this totality is time dependent and its description can need a statistical approach.

[SOURCE: IEC 60050-161:2018, 161-01-01]

3.1.4

electromagnetic disturbance

electromagnetic phenomenon that can degrade the performance of a device, equipment or system, or adversely affect living or inert matter

Note 1 to entry: An electromagnetic disturbance may be an electromagnetic noise, an unwanted signal or a change in the propagation medium itself

[SOURCE: IEC 60050-161:1990, 161-01-05]

3.1.5

electromagnetic interference

EMI

degradation in the performance of equipment or transmission channel or a system caused by an electromagnetic disturbance

Note 1 to entry: Disturbance and interference are cause and effect, respectively.

Note 2 to entry: The English words "interference" and "disturbance" are often used indiscriminately.

[SOURCE: IEC 60050-161:2018, 161-01-06, modified – Note 1 and Note 2 have been revised.]

3.1.6

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 terms "device" and "equipment" have been added to the definition.]

3.1.7

electromagnetic emission

phenomenon by which electromagnetic energy emanates from a source

[SOURCE: IEC 60050-161:2019, 161-01-08]

3.1.8**emission level (of a disturbing source)**

level of a given electromagnetic disturbance emitted from a particular device, equipment or system, measured in a specified way

[SOURCE: IEC 60050-161:1990, 161-03-11, modified – “measured in a specified way” has been added.]

3.1.9**emission limit (from a disturbing source)**

specified maximum emission level of a source of electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-03-12]

3.1.10**emission margin**

ratio of the electromagnetic compatibility level to the emission limit

Note 1 to entry: If the levels are expressed in dB(...), in the above margin definitions “difference” is used instead of “ratio” and “sum” instead of “product”.

[SOURCE: IEC 60050-161:1990, 161-03-13, modified – the note has been added.]

3.1.11**degradation (of performance)**

undesired deviation in the operational performance of any device, equipment or system from its intended performance

Note 1 to entry: The term “degradation” can apply to temporary or permanent failure

[SOURCE: IEC 60050-121:1990, 161-01-19]

3.1.12**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]

3.1.13**immunity (to a disturbance)**

ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-01-20]

3.1.14**immunity level**

maximum level of a given electromagnetic disturbance, incident in a specified way on a particular device, equipment or system, at which no degradation of operation occurs

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

3.1.15**immunity limit**

minimum permissible immunity level

Note 1 to entry: In some product/product family standards the term test level is used to express what is meant by immunity limit.

3.1.16

immunity margin

ratio of the immunity limit to the electromagnetic compatibility level

Note 1 to entry: If the levels are expressed in dB(...), in the above margin definitions "difference" is used instead of "ratio" and "sum" instead of "product".

[SOURCE: IEC 60050-161:1990, 161-03-16, modified – the note has been added.]

3.1.17

level (of a time varying quantity)

magnitude value of a quantity, such as a power or a field quantity, measured and/or evaluated in a specified manner during a specified time interval

Note 1 to entry: The level of a quantity can be expressed in logarithmic units, for example decibels with respect to a reference value.

[SOURCE: IEC 60050-161:1990, 161-03-01]

3.1.18

(electromagnetic) susceptibility

inability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

Note 1 to entry: Susceptibility is a lack of immunity.

[SOURCE: IEC 60050-161:1990, 161-01-21]

3.2 Abbreviated terms

AC	alternating current
DC	direct current
EM	electromagnetic
EMC	electromagnetic compatibility
EMI	electromagnetic interference
RF	radio frequency

4 The electromagnetic environment

4.1 General

There are various approaches that can be used for describing the electromagnetic environment at a considered location. Classification in terms of typical environmental locations such as industrial, residential and commercial can have some meaning in that each of these tends to imply some general characteristics of the electromagnetic environment on which compatibility levels can be based. However, it is recognized that equipment not normally associated with a particular environmental location class can indeed affect the electromagnetic environment at any specific location.

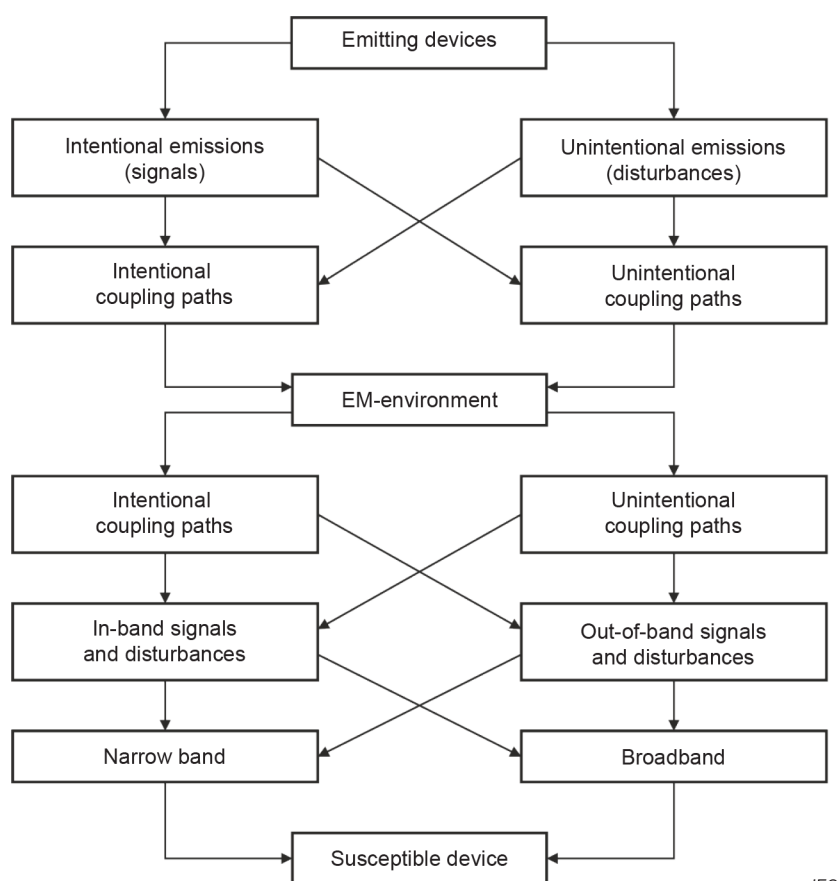
For the above reason, the approach taken in this document is to indicate the electromagnetic levels expected from particular sources or classes of sources. The level expected at a particular location will be determined with reference to the sources existing at that location. IEC TR 61000-2-5 provides a description of the electromagnetic environment with anticipated disturbance levels for typical location classes.

At the same time, it is recognized that one cannot always identify all sources that can affect a particular environment. Such is the case, for example, with conducted disturbances in a power system generated at large distances, for example large distant nonlinear industrial loads or unpredictable exceptionally severe lightning strokes. It is meaningful to make a distinction between public supply and industrial or private networks.

The quality of the provided power supply at the point of common connection due to remote users will depend upon the capacity of the network and the loads connected to it that an individual consumer knows little about. Voltage fluctuations can be caused by load switching as well as by system faults and lightning strokes. Within a consumer's system, residential or industrial, the low frequency effects of local loads can be predicted. In general, one would expect the remote sources to limit the quality of service delivered to a particular consumer location, and that any given system needs to perform properly in the absence of local sources. This is assuming that the quality of service is otherwise satisfactory. Local sources can be expected to have more significant effects in possible system and device degradation.

4.2 Coupling between emitting and susceptible devices

The major reason for considering electromagnetic compatibility is the existence of devices (equipment, systems) which show susceptibility to electromagnetic emission from other devices.



IEC

Figure 1 – Coupling paths between emitting and susceptible devices

Emitting devices can have intentional emissions, such as a radio-frequency broadcasting signal, or unintentional emissions. Through various coupling paths such emissions can reach the site where a susceptible device is located as shown in Figure 1, thereby establishing the electromagnetic environment for that device. The subdivisions shown in Figure 1 are important for a description of the electromagnetic environment. Moreover, the technical possibilities available to prevent or solve an interference problem are related to these subdivisions, as are also the relevant EMC specifications.

The susceptible device can be exposed to the electromagnetic environment via intentional coupling paths, such as the aerial of a radio receiver, or via unintentional coupling paths such as the recording head of a video tape recorder, a signal cable or a mains cable. Both types of coupling paths, intentional and unintentional, can carry disturbances having frequency components in the frequency band designated for the desired signal of the susceptible device, and disturbances having components outside that band.

The disturbances received can be considered narrow band or broadband. For example, the disturbance from a switched-mode power supply operating at 40 kHz and its harmonics is narrow band when the bandwidth of the effected radio service is far broader than the bandwidth of the disturbances.

5 Application of EMC terms and definitions

5.1 General

The definitions given in Clause 3 are basic conceptual definitions. When they are applied to assign specific values to the levels in a particular case, several considerations are necessary. A number of these are given in Clause 5, together with examples which will elucidate them. For an interpretation of the various terms used, see Annex A and Annex B.

The basic devices or systems can be divided into two groups:

- 1) emitters – devices, equipment or systems which emit potentially disturbing voltages, currents or fields, and
- 2) susceptible devices – devices, equipment or systems whose operation might be degraded by those emissions.

Some devices can belong simultaneously to both groups.

5.2 Relation between various types of levels

5.2.1 Emissions and immunity level (and limit)

A possible combination of an emission level and an immunity level and their associated limits as a function of some independent variable, for example the frequency, for a single type of emitter and a single type of susceptible device, is illustrated in Figure 2.

In Figure 2, the emission level is always lower than its maximum permissible level (the emission limit), and the immunity level is always higher than its minimum required level (the immunity limit). In the illustrated scenario, the emitter and the susceptible device comply with their specified limit. In addition, the immunity limit has been chosen to be higher than the emission limit, and it has been assumed that the levels and limits are continuous functions of the independent variable. These levels and limits can also be discrete functions of some independent variable, see 5.2.3.1.

Further to the above, the following observations are noted:

- a) By drawing the emission and immunity levels (and the associated limits) in one figure it is assumed that only one particular disturbance is considered, unless it is clearly indicated that different disturbances are considered and the relationship between the different disturbances is also indicated.
- b) Drawing the emission and immunity levels in one figure is only relevant when there is a good interrelation between the specified way the emission level of the particular disturbance is measured and the specified way that type of disturbance is incident on the equipment under test. If this is the case, Figure 2 indicates an electromagnetically compatible situation.