

TECHNICAL REPORT



BASIC EMC PUBLICATION

**Electromagnetic compatibility (EMC) –
Part 2-5: Environment – Description and classification of electromagnetic
environments**

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CONTENTS

FOREWORD	7
1 Scope	9
2 Normative references	10
3 Terms, definitions and abbreviated terms	11
3.1 Terms and definitions.....	11
3.2 Abbreviated terms.....	18
4 User's guide for this document.....	22
4.1 Approach	22
4.2 Rationale for classification system	24
4.3 Electromagnetic environment phenomena.....	25
4.4 Relationship of disturbance levels to CISPR limits	26
4.5 Simplification of the electromagnetic environment database.....	26
5 Low-frequency electromagnetic phenomena	30
5.1 Conducted low-frequency phenomena	30
5.1.1 Harmonics of the fundamental power frequency.....	30
5.1.2 Power supply network voltage amplitude and frequency changes	32
5.1.3 Power supply network common mode voltages	34
5.1.4 Signalling voltages in power supply networks.....	37
5.1.5 Islanding supply networks.....	38
5.1.6 Induced low-frequency voltages.....	39
5.1.7 DC voltage in AC networks.....	39
5.2 Radiated low-frequency phenomena.....	40
5.2.1 Magnetic fields	40
5.2.2 Electric fields.....	41
6 High-frequency electromagnetic phenomena	42
6.1 Conducted high-frequency phenomena	42
6.1.1 General	42
6.1.2 Direct conducted CW phenomena.....	43
6.1.3 Induced continuous wave.....	47
6.1.4 Transients	47
6.2 Radiated high frequency phenomena	50
6.2.1 General	50
6.2.2 Radiated continuous oscillatory disturbances.....	52
6.2.3 Radiated modulated disturbances	52
6.2.4 Radiated pulsed disturbances.....	75
7 Electrostatic discharge	77
7.1 General.....	77
7.2 ESD currents	77
7.3 Fields produced by ESD currents.....	78
8 Classification of environments	79
8.1 General.....	79
8.2 Location classes	79
8.3 Residential location class.....	81
8.3.1 Description of residential locations	81
8.3.2 Equipment typical to the residential location	81

8.3.3	Boundaries relevant for equipment operated at residential locations	82
8.3.4	Interfaces and ports to residential locations	83
8.3.5	Attributes of residential locations	83
8.4	Commercial/public location class	85
8.4.1	Description of commercial/public locations	85
8.4.2	Equipment and interference sources existent in commercial/public locations	85
8.4.3	Boundaries relevant for equipment operated at commercial/public locations	85
8.4.4	Interfaces and ports to commercial/public locations	86
8.4.5	Attributes of commercial/public locations	86
8.5	Industrial location class	89
8.5.1	Description of industrial locations	89
8.5.2	Equipment and interference sources present in industrial locations	90
8.5.3	Boundaries relevant for equipment operated at industrial locations	90
8.5.4	Interfaces and ports to industrial locations	91
8.5.5	Attributes of industrial locations	91
8.6	Types of power supply networks	93
8.7	Alterations in electromagnetic environments	95
8.7.1	General	95
8.7.2	The electromagnetic environments of Smart Grid	96
8.8	Further conducted electromagnetic phenomena	96
8.8.1	Description of conducted phenomena other than those in Clause 4 and Clause 5	96
8.8.2	Repetitive electrical impulse noise	97
8.8.3	Single high intensity noise event	98
8.9	Mitigation aspects	98
8.10	Description of location classes with regard to the requirements of EMC basic standards	99
9	Principles of the selection of immunity levels	102
9.1	Approach	102
9.2	Uncertainties	102
9.2.1	Uncertainties in the test situation	102
9.2.2	Uncertainties in the application situation	102
9.2.3	Dealing with uncertainties	102
9.3	Dealing with high density sources	103
9.4	Criticality criteria	103
10	Disturbance levels of the various location classes	104
Annex A (informative)	Compatibility levels/disturbance levels for location classes	105
Annex B (informative)	Radiated continuous disturbances	115
Annex C (informative)	Review of the historical assignment of radiated disturbance degrees	124
C.1	General	124
C.2	Revised analysis of radiated disturbance degrees	124
C.2.1	Analysis	124
C.2.2	Detailed derivations	126
Annex D (informative)	Radiated pulsed disturbances	130
Annex E (informative)	Power line telecommunications (PLT)	135
Annex F (informative)	Distributed generation	137

Annex G (informative) Information on disturbance and compatibility levels available in documents of the IEC 61000-2 series	138
Bibliography.....	142
Figure 1 – Schematic of the two-step approach used for classification with phenomenon-oriented input tables and location-oriented output tables	23
Figure 2 – Ports of entry (POEs) of electromagnetic disturbances into equipment.....	24
Figure 3 – Typical voltage waveforms for dip and interruption (10 ms/horizontal division).....	33
Figure 4 – Typical configuration of the converter in a PDS	35
Figure 5 – Voltage and current waveforms of each PDS portion (1 ms/horizontal division).....	36
Figure 6 – Measured common mode voltage at the input terminal of a converter.....	36
Figure 7 – Concept of location classes.....	80
Figure 8 – Situation for TN-C power installation systems	94
Figure 9 – Situation for TN-S power installation systems.....	95
Figure 10 – Examples of electromagnetic environments associated with the Smart Grid	96
Figure B.1 – Typical waveforms for radiated disturbances.....	116
Figure C.1 – Problem geometry	125
Figure D.1 – Measured electric field and electric field derivative from a cloud-to-ground lightning strike measured at a distance of 30 m.....	130
Figure D.2 – Measured electric field from an electrostatic discharge event at a distance of 0,1 m	131
Figure D.3 – Measured magnetic field (two measurements) from an electrostatic discharge event at a distance of 0,1 m	131
Figure D.4 – Measured electric field in kV/m versus time in μ s in a 500 kV power substation	132
Figure F.1 – Example of disturbance voltages for electrical energy storage system (140 kVA) in situ with the frequency range of 9 kHz to about 30 MHz.....	137
Figure F.2 – Example of disturbance voltages from a photovoltaic inverter (21 kW) in situ with the frequency range of 9 kHz to about 30 MHz.....	137
Table 1 – Principal phenomena causing electromagnetic disturbances	28
Table 2 – Disturbance degrees and levels for harmonic voltages in power supply networks (in percentage to fundamental voltage, U_n/U_1).....	32
Table 3 – Disturbance degrees and levels for voltage changes within normal operating range (in percentage of nominal voltage, $\Delta U/U_n$)	33
Table 4 – Disturbance degrees and levels for voltage unbalance (in percentage of U_{neg}/U_{pos})	34
Table 5 – Disturbance degrees and levels for power frequency variation	34
Table 6 – Disturbance degrees and levels for common mode voltages.....	37
Table 7 – Disturbance degrees and levels for signalling voltages in low and medium-voltage systems (in per cent of nominal voltage U_n)	38
Table 8 – Disturbance degrees and levels for low-frequency, common mode induced voltages in signal and control cables.....	39
Table 9 – Disturbance degrees and levels for low-frequency magnetic fields at various frequencies.....	41
Table 10 – Disturbance degrees and levels for low-frequency electric fields	42

Table 11 – Disturbance degrees and levels of direct CW voltages	46
Table 12 – Disturbance degrees and levels of induced CW voltages with respect to reference ground	47
Table 13 – Disturbance degrees and levels for conducted unidirectional transients in low-voltage AC power systems	49
Table 14 – Disturbance degrees and levels for conducted oscillatory transients in low-voltage AC power systems	50
Table 15 – Radiation sources.....	51
Table 16 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Radiated continuous oscillatory disturbances.....	52
Table 17 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Amateur radio bands below 30 MHz.....	54
Table 18 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – 27 MHz CB band	55
Table 19 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Analogue communication services below 30 MHz	56
Table 20 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Analogue communication services above 30 MHz	57
Table 21 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Mobile and portable phones	57
Table 22 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Mobile and portable phones (continued)	58
Table 23 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Base stations.....	60
Table 24 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Base stations (continued).....	61
Table 25 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Medical and biological telemetry items.....	63
Table 26 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Digital-television broadcast (VHF).....	64
Table 27 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Digital-television broadcast (UHF).....	65
Table 28 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Digital-television broadcast (UHF) (continued)	66
Table 29 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Unlicensed radio services	67
Table 30 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Unlicensed radio services (continued).....	68
Table 31 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Amateur radio bands above 30 MHz	69
Table 32 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Paging service base station	70
Table 33 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Other RF items (1 of 6).....	70
Table 34 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Other RF items (2 of 6).....	71
Table 35 – Disturbance degrees, levels (in V/m, rms) and distance to source – Other RF items (3 of 6).....	71
Table 36 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Other RF items (4 of 6).....	72

Table 37 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – Other RF items (5 of 6).....	72
Table 38 – Disturbance degrees, levels (in V/m, rms) and distance to source – Other RF items (6 of 6).....	73
Table 39 – Disturbance degrees, levels (in V/m, r.m.s.) and distance to source – RFID and railway transponder systems.....	74
Table 40 – Disturbance degrees, levels (in $\mu\text{A}/\text{m}$, r.m.s.) and distance to source – RFID and railway transponder systems.....	75
Table 41 – Disturbance degrees, levels (in rate of rise) and distance to source – Radiated pulsed disturbances.....	76
Table 42 – Disturbance degrees, levels (in V/m, Pk) and distance to source – RADAR systems.....	77
Table 43 – Disturbance degrees and levels for pulsed disturbances (rate of rise) caused by ESD.....	78
Table 44 – Disturbance degrees and levels for radiated field gradients caused by ESD.....	78
Table 45 – Examples of equipment present in the residential location class.....	82
Table 46 – Attributes of the residential location class.....	84
Table 47 – Attributes of various types of the commercial/public location class.....	88
Table 48 – Attributes of various types of the industrial location class.....	92
Table 49 – Overview of phenomena versus basic standard, related table and subclause....	100
Table A.1 – Disturbance levels in the residential location class.....	106
Table A.2– Disturbance levels in the commercial/public location class.....	109
Table A.3 – Disturbance levels in the industrial location class.....	112
Table B.1 – Examples of field strengths from authorized transmitters.....	117
Table B.2 – Specifications of mobile and portable units.....	118
Table B.3 – Specifications of base stations.....	119
Table B.4 – Specification of other typical RF items.....	119
Table B.5 – Data regarding RFID technology.....	120
Table B.6 – Frequency allocations of TETRA system (in Europe).....	120
Table B.7 – Amateur radiofrequencies (ITU regions 1 to 3).....	121
Table C.1 – Radiated disturbance degrees defined in Edition 1.....	124
Table D.1 – Data regarding RADAR systems.....	133
Table D.2– Examples for civil RADAR systems.....	134
Table G.1 – Overview of the IEC 61000-2 series.....	139

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 2-5: Environment –
Description and classification of electromagnetic environments**

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IEC 61000-2-5, which is a technical report, has been prepared by technical committee 77: Electromagnetic compatibility.

It forms Part 2-5 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This third edition cancels and replaces the second published in 2011. This edition constitutes a technical revision.

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

- a) the description of the radiated electromagnetic environment has been updated taking into account recent communication technologies;
- b) some conducted phenomena and respective interference sources have been described in more detail.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
77/525A/DTR	77/526/RVC

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The reader's attention is drawn to the fact that Annex E lists some "in-some-country" clauses on differing practices regarding a particular electromagnetic phenomenon.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2-5: Environment – Description and classification of electromagnetic environments

1 Scope

Knowledge of the electromagnetic environment that exists at locations where electrical and electronic equipment and systems are intended to be operated is an essential precondition in the process of achieving electromagnetic compatibility. This knowledge can be obtained by various approaches, including a site survey of an intended location, the technical assessment of the equipment and system, as well as the general literature.

This part of IEC 61000

- introduces the concept of disturbance degrees and defines these for each electromagnetic phenomena,
- classifies into various location classes and describes them by means of attributes,
- provides background information on the different electromagnetic phenomena that may exist within the environment and
- compiles tables of compatibility levels for electromagnetic phenomena that are considered to be relevant for those location classes.

This part of IEC 61000 is intended for guidance for those who are in charge of considering and developing immunity requirements. It also gives basic guidance for the selection of immunity levels. The data are applicable to any item of electrical or electronic equipment, sub-system or system that operates in one of the locations as considered in this document.

NOTE 1 This document considers relevant electromagnetic phenomena when describing and classifying electromagnetic environments (except HEMP and HPEM which are covered in other IEC 61000-2 standards). It makes use of the specification of technologies, of published data and of results from measurements. Not all electromagnetic phenomena considered here are described in detail in this document, but rather in other documents of the IEC 61000-2 series from which the relevant information and data are taken and used in this document. For more detailed information about those phenomena the user is referred to this series. See also Annex F for an overview of the various parts of the IEC 61000-2 series.

NOTE 2 It is noted that immunity requirements and immunity levels determined for items of equipment which are intended to be used at a certain location class are not inevitably bound to the electromagnetic environment present at the location, but also to requirements of the equipment itself and the application in which it is used (e.g. when taking into account requirements regarding availability, reliability or safety). These could lead to more stringent requirements with respect to immunity levels or with respect to applicable performance criteria. These levels can also be established for more general purposes such as in generic and product standards, taking into account statistical and economic aspects as well as common experience in certain application fields.

NOTE 3 Electromagnetic phenomena in general show a broad range of parameters and characteristics and hence cannot be related one-to-one to standardized immunity tests which basically reflect the impact of electromagnetic phenomena by a well described test setup. Nonetheless, this document follows an approach to correlate electromagnetic phenomena and standardized immunity tests up to a certain extent. This might allow users of this document to partly take into account standardized immunity tests such as given for example in IEC 61000-4(all parts), when specifying immunity requirements.

The descriptions of electromagnetic environments in this document are predominantly generic ones, taking into account the characteristics of the location classes under consideration. Hence, it should be kept in mind that there might be locations for which a more specific description is required in order to conclude on immunity requirements applicable for those specific locations.

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 – Chapter 161: Electromagnetic compatibility* (available at www.electropedia.org)

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

IEC TR 61000-2-3, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 3: Description of the environment – Radiated and non-network-frequency-related conducted phenomena*

IEC 61000-2-4, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC TR 61000-2-8, *Electromagnetic compatibility (EMC) – Part 2-8: Environment – Voltage dips and short interruptions on public electric power supply systems with statistical measurement results*

IEC 61000-2-9, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 9: Description of HEMP environment – Radiated disturbance*

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 61000-2-13, *Electromagnetic compatibility (EMC) – Part 2-13: Environment – High-power electromagnetic (HPEM) environments – Radiated and conducted*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

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

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-9, *Electromagnetic compatibility (EMC) – Part 4-9: Testing and measurement techniques – Impulse magnetic field immunity test*

IEC 61000-4-10, *Electromagnetic compatibility (EMC) – Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-12, *Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Ring wave immunity test*

IEC 61000-4-13, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*

IEC 61000-4-14, *Electromagnetic compatibility (EMC) – Part 4-14: Testing and measurement techniques – Voltage fluctuation immunity test for equipment with input current not exceeding 16 A per phase*

IEC 61000-4-16:2015, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-18, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-19, *Electromagnetic compatibility (EMC) – Part 4-19: Testing and measurement techniques – Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports*

IEC 61000-4-27, *Electromagnetic compatibility (EMC) – Part 4-27: Testing and measurement techniques – Unbalance, immunity test for equipment with input current not exceeding 16 A per phase*

IEC 61000-4-28, *Electromagnetic compatibility (EMC) – Part 4-28: Testing and measurement techniques – Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase*

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

active infeed converter

AIC

self-commutated electronic power converter of all technologies, topologies, voltages and sizes which is connected between the AC power supply network (lines) and usually a stiff DC side (current source or voltage source) and which can convert electric power in both directions (generative or regenerative) and control the reactive power or the power factor

Note 1 to entry: Some active infeed converters can additionally control the harmonics to reduce the distortion of an applied AC voltage or current.

3.1.2

blackout

cutoff of electrical power, especially as a result of shortage, mechanical failure, or overuse by consumers

EXAMPLE A power cut due to a short- or long-term electric power loss in an area.

3.1.3

brownout

reduction or cutback in electric power, especially as a result of shortage, mechanical failure, or overuse by consumers

EXAMPLE Reduction in the voltage of commercially supplied power. It is caused by the failure of the generation, transmission, or distribution system, or deliberately by the power utility when demand exceeds supply. The consumer may or may not notice the difference. In the worst case, damage may result.

3.1.4

burst

sequence of a limited number of distinct pulses or an oscillation of limited duration

[SOURCE: IEC 60050-161:1990, 161-02-07]

3.1.5

burst (in TDMA)

signals transmitted by a terminal in the form of a block of predetermined structure during a time interval allotted to the terminal by a TDMA protocol

[SOURCE: IEC 60050-725:1994, 725-14-15]
<https://standards.iteh.ai/catalog/standards/sist/0c013217-1ec4-47ef-a54d-ce707f329d18/iec-tr-61000-2-5-2017>

3.1.6

characteristic impedance of a medium

wave impedance for a travelling wave in a specific medium

Note 1 to entry: The characteristic impedance of a homogeneous isotropic medium is given by $\eta_t = \sqrt{\frac{\mu}{\varepsilon}}$,

where

μ is the permeability of the homogeneous isotropic medium, and

ε is the permittivity of the homogeneous isotropic medium.

[SOURCE IEC 60050-705:1995, 705-03-23, modified – the formula for characteristic impedance has been simplified.]

3.1.7

commercial, public and light-industrial location

location which exists as areas of the city centre, offices, public transport systems (road/train/underground), and modern business centres containing a concentration of office automation equipment (PCs, fax machines, photocopiers, telephones, etc.), and characterized by the fact that equipment is directly connected to a low-voltage public mains network or connected to a dedicated DC source which is intended to interface between the equipment and the low-voltage mains network

EXAMPLE Examples of commercial, public or light-industrial locations are:

- retail outlets, for example shops, supermarkets;
- business premises, for example offices, banks, hotels, data centers;
- areas of public entertainment, for example cinemas, public bars, dance halls;

- places of worship, for example temples, churches, mosques, synagogues;
- outdoor locations, for example petrol stations, car parks, amusement and sports centers;
- general public locations, for example park, amusement facilities, public offices;
- hospitals, educational institutions, for example schools, universities, colleges;
- public traffic area, railway stations, and public areas of an airport;
- light-industrial locations, for example workshops, laboratories, service centers.

Note 1 to entry: The connection between location and electromagnetic environment is given in 3.1.15.

3.1.8

(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]

3.1.9

disturbance degree

specified and quantified intensity within a range of disturbance levels corresponding to a particular electromagnetic phenomenon encountered in the environment of interest

3.1.10

disturbance level

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

3.1.11

earth port

cable port other than signal, control or power port, intended for connection to earth

3.1.12

electric field

constituent of an electromagnetic field which is characterized by the electric field strength E together with the electric flux density D

[SOURCE: IEC 60050-121:1998, 121-11-67]

3.1.13

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 60050-161:1990, 161-01-07, modified – the terms "device" and "equipment" have been added to the definition.]

3.1.14

electromagnetic disturbance

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