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BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

**Electromagnetic compatibility (EMC) –
Part 1-2: General – Methodology for the achievement of functional safety of
electrical and electronic systems including equipment with regard to
electromagnetic phenomena**

[IEC 61000-1-2:2016](#)

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**Compatibilité électromagnétique (CEM) –
Partie 1-2: Généralités – Méthodologie pour la réalisation de la sécurité
fonctionnelle des systèmes électriques et électroniques, y compris les
équipements, du point de vue des phénomènes électromagnétiques**

[IEC 61000-1-2:2016](#)



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena

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International Standard IEC 61000-1-2 has been prepared by technical committee 77: Electromagnetic compatibility.

It has the status of a basic safety publication in accordance with IEC Guide 104.

This first edition cancels and replaces the second edition of IEC TS 61000-1-2 published in 2008. This edition constitutes a technical revision.

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

- Alignment with the changes done in the latest edition of the functional safety standard IEC 61508.

- Complete review with regard to transforming this document into an International Standard (instead of the previous edition as Technical Specification).
- New structure of Annex B.

The text of this standard is based on the following documents:

FDIS	Report on voting
77/513/FDIS	77/519/RVD

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

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

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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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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 (insofar 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 completed by a second number identifying the subdivision (example: IEC 61000-3-11).

Particular considerations for IEC 61000-1-2

The aim of this international standard with regard to EMC and functional safety is to address the possible effects of electromagnetic disturbances on safety-related systems and to specify requirements for the relevant phases of the lifecycle of a safety-related system. The objective is to achieve the systematic capability as specified in the electrical/electronic/programmable electronic system safety requirements specification with regard to electromagnetic aspects.

This document makes use of existing relevant basic IEC standards, as far as appropriate. It considers the work of SC 65A relating to functional safety concepts of the IEC 61508 series and of TC 77 and its subcommittees relating to the electromagnetic environments. More details can be found in the publications of these committees.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena

1 Scope

This part of IEC 61000 establishes a methodology for the achievement of functional safety only with regard to electromagnetic phenomena. This methodology includes the implication it has on equipment used in such systems and installations.

This standard:

- a) applies to safety-related systems and installations incorporating electrical/electronic/programmable electronic equipment as installed and used under operational conditions;
- b) considers the influence of the electromagnetic environment on safety-related systems;
- c) is not concerned with direct hazards from electromagnetic fields on living beings nor is it concerned with safety related to breakdown of insulation or other mechanisms by which persons can be exposed to electrical hazards.

It mainly covers EMC related aspects of the design and application specific phases of safety-related systems and equipment used therein, and deals in particular with

- some basic concepts in the area of functional safety,
- the various EMC specific steps for the achievement and management of functional safety,
- the description and assessment of the electromagnetic environment,
- the EMC aspects of the design and integration process, taking into account the process of EMC safety planning on system as well as on equipment level,
- the validation and verification processes regarding the immunity against electromagnetic disturbances,
- the performance criterion and some test philosophy considerations for safety-related systems and the equipment used therein,
- aspects related to testing of the immunity of safety-related systems and equipment used therein against electromagnetic disturbances.

This International Standard is applicable to electrical/electronic/programmable electronic (E/E/PE) safety-related systems intended to comply with the requirements of IEC 61508 and/or associated sector-specific functional safety standards. It is intended for designers, manufacturers, installers and users of safety-related systems and can be used as a guide by IEC committees.

For safety-related systems covered by other functional safety standards, the requirements of this standard should be considered in order to identify the appropriate measures that should be taken with relation to EMC and functional safety.

NOTE This standard can also be used as a guide for considering EMC requirements for other systems having a direct contribution to safety.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*

IEC TR 61000-1-6, *Electromagnetic compatibility (EMC) – Part 1-6: General – Guide to the assessment of measurement uncertainty*

IEC TR 61000-2-5, *Electromagnetic compatibility (EMC) – Part 2-5: Environment – Description and classification of electromagnetic environments*

IEC 61000-4-X (all parts), *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques*

IEC 61000-4-1, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*

IEC 61000-6-7, *Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

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3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1

degradation (of performance)

undesired departure 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 60050-161:1990, 161-01-19]

3.1.2

electrical/electronic/programmable electronic E/E/PE

based on electrical and/or electronic and/or programmable electronic technology

Note 1 to entry: The term is intended to cover any and all devices or systems operating on electrical principles.

EXAMPLE Electrical/electronic/programmable electronic devices include

- electro-mechanical devices (electrical);
- solid-state non-programmable electronic devices (electronic);
- electronic devices based on computer technology (programmable electronic).

[SOURCE: IEC 61508-4:2010, 3.2.13]

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

[SOURCE: IEC 60050-161:1990, 161-01-07]

3.1.4

EMC planning

engineering method by which EMC aspects of a project are systematically considered and investigated in order to achieve EMC

Note 1 to entry: All activities connected to EMC planning are described in an EMC plan.

3.1.5

E/E/PE system

system for control, protection or monitoring based on one or more electrical/electronic programmable electronic (E/E/PE) devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communications paths, and actuators and other output devices

[SOURCE: IEC 61508-4:2010, 3.3.2]

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3.1.6

E/E/PE system safety integrity requirements specification

specification containing the safety integrity requirements of the safety functions that have to be performed by the safety-related systems

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Note 1 to entry: This specification is one part (the safety integrity part) of the E/E/PE system safety requirements specification (see 7.10 and 7.10.2.7 of IEC 61508-1:2010).

3.1.7

**E/E/PE system safety requirements specification
SSRS**

specification containing, for each safety function, the safety function requirements (what the function does), and the safety integrity requirements (the likelihood of the safety function being performed satisfactorily) that have to be performed/met by the safety-related systems

Note 1 to entry: This note applies to the French language only.

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 the 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 the 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**electromagnetic disturbance**

any electromagnetic phenomenon which may degrade the performance of a device, equipment or system

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, modified – the words " or adversely affect living or inert matter" have been deleted]

3.1.10**electromagnetic environment**

totality of electromagnetic phenomena existing at a given location

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

3.1.11**electromagnetic interference****EMI**

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

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

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 60050-161:1990, 161-01-06]

3.1.12**element**

part of a system comprising a single component or any group of components that performs one or more element safety functions.

Note 1 to entry: An element may comprise hardware and/or software.

Note 2 to entry: A typical element is a sensor, programmable controller or final element

[SOURCE: IEC 61508-4:2010, 3.4.5, modified – the word "subsystem" has been replaced by "system"]

3.1.13**element safety function**

that part of a safety function which is implemented by an element

[SOURCE: IEC 61508-4:2010, 3.5.3]

3.1.14**equipment**

general term that refers to a wide variety of possible elements, modules, devices and assemblies of products

3.1.15**equipment under control****EUC**

equipment, machinery, apparatus or plant used for manufacturing, process, transportation, medical or other activities

Note 1 to entry: The EUC control system is separate and distinct from the EUC.

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 61508-4:2010, 3.2.1]

3.1.16 equipment requirements specification ERS

equipment specification covering safety-related requirements only with regard to electromagnetic phenomena

Note 1 to entry: An equipment requirements specification (ERS) is created for each item of equipment within the safety-related system. Included in each equipment requirements specification is an electromagnetic characteristics specification based upon the maximum electromagnetic environment expected over the lifetime for that particular item of equipment.

Note 2 to entry: This note applies to the French language only.

3.1.17 failure

termination of the ability of a functional unit to provide a required function or operation of a functional unit in any way other than as required

Note 1 to entry: This is based on IEC 60050-191:1990, 191-04-01, with changes to include systematic failures due to, for example, deficiencies in specification or software.

Note 2 to entry: See IEC61508-4 for the relationship between faults and failures, both in the IEC 61508 series and IEC 60050-191.

Note 3 to entry: Performance of required functions necessarily excludes certain behaviour, and some functions may be specified in terms of behaviour to be avoided. The occurrence of such behaviour is a failure.

Note 4 to entry: Failures are either random (in hardware) or systematic (in hardware or software), see IEC 61508-4.

[SOURCE: IEC 61508-4:2010, 3.6.4, modified – in Notes 2 and 4 to entry, the figure and subclause numbers have been replaced by IEC 61508-4.]

3.1.18 fault

abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function

Note 1 to entry: IEC 60050:1990, 191-05-01, defines “fault” as a state characterised by the inability to perform a required function, excluding the inability during preventative maintenance or other planned actions, or due to lack of external resources.

[SOURCE: ISO/IEC 2382-14:1997, 14.01.10]

3.1.19 functional safety

part of the overall safety relating to the EUC and the EUC control system that depends on the correct functioning of the E/E/PE safety-related systems and other risk reduction measures

Note 1 to entry: In the context of this EMC document, functional safety is that part of the overall safety relating to the electromagnetic environment in which the safety-related system exists.

[SOURCE: IEC 61508-4:2010, 3.1.12, modified – a note has been added.]

3.1.20 installation

combination of equipment, components and systems assembled and/or erected (individually) in a given area

3.1.21 safety function

function to be implemented by an E/E/PE safety-related system or other risk reduction measures, that is intended to achieve or maintain a safe state for the EUC, in respect of a specific hazardous event

EXAMPLE Examples of safety functions include:

- functions that are required to be carried out as positive actions to avoid hazardous situations (for example switching off a motor); and
- functions that prevent actions being taken (for example preventing a motor starting).

[SOURCE: IEC 61508-4:2010, 3.5.1]

3.1.22 safety integrity level SIL

discrete level (one out of a possible four), corresponding to a range of safety integrity values, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

Note 1 to entry: The target failure measures for the four safety integrity levels are specified in Tables 2 and 3 of IEC 61508-1:2010.

Note 2 to entry: Safety integrity levels are used for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems.

Note 3 to entry: A safety integrity level (SIL) is not a property of a system, element or component. The correct interpretation of the phrase "SIL *n* safety-related system" (where *n* is 1, 2, 3 or 4) is that the system is potentially capable of supporting safety functions with a safety integrity level up to *n*.

Note 4 to entry: This note applies to the French language only.

[SOURCE: IEC 61508-4:2010, 3.5.8]

3.1.23 safety manual for compliant items

document that provides all the information relating to the functional safety of an element, in respect of specified element safety functions, that is required to ensure that the system meets the requirements of IEC 61508 series

3.1.24 safety-related system

designated system that both

- implements the required safety functions necessary to achieve or maintain a safe state for the EUC; and
- is intended to achieve, on its own or with other E/E/PE safety-related systems and other risk reduction measures, the necessary safety integrity for the required safety functions

Note 1 to entry: A safety-related system includes all the hardware, software and supporting services (for example, power supplies) necessary to carry out the specified safety function (sensors, other input devices, final elements (actuators) and other output devices are therefore included in the safety-related system).

Note 2 to entry: For further information, see IEC 61508-4.

[SOURCE: IEC 61508-4:2010, 3.4.1, modified – the original note 2 has been modified.]

3.1.25 systematic capability

measure (expressed on a scale of SC 1 to SC 4) of the confidence that the systematic safety integrity of an element meets the requirements of the specified SIL, in respect of the specified element safety function, when the element is applied in accordance with the instructions specified in the compliant item safety manual for the element