STATE-OF-THE-ART STANDARDS
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CENELEC

CENELEC Guide n° 24

Electromagnetic Compatibility (EMC) Standardization for Product Committees

Early 1998, CENELEC/TC 210 "EMC" decided to review the CENELEC Report R210-001.1993: *Report on EMC Standardisation for Product Committees*. After consultation at national level in December 1998 a revised draft was approved in 1999. The Technical Board authorized its issuing as R210-001:200X: *Electromagnetic Compatibility (EMC) Standardization for Product Committees* in March 2000 (ref.: BT decision D103/069) and in July 2001 the Technical Board resolved to convert this CENELEC Report into CENELEC Guide 24 (ref.: BT decision D108/222).

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EMC Standardization for Product Committees

Foreword

This CENELEC Guide has been prepared by CENELEC Technical Committee TC*210*, EMC. It was approved by CENELEC initially as CENELEC Report R210-001:200X and in July 2001 as CENELEC Guide 24.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

INTRODUCTION

The Council of the European Communities has adopted the Directive 89/336/EEC (the EMC-directive) concerning Electromagnetic Compatibility (EMC). The Directive concerns both immunity and emission over the whole frequency range.

The European Commission has given CENELEC and ETSI the task of preparing and harmonising the necessary standards for the implementation of this directive.

Note: ETSI/CENELEC Report ROBT 001 defines the CENELEC/ETSI standardisation program for the development of harmonised standards in the field of radio and telecommunication equipment.

These standards are necessary to enable the presumption of conformity to the protection requirements of the EMC Directive using article 10.1 and are designed to satisfy those protection requirements. Conformance to the appropriate standards will facilitate the free movement of apparatus placed on the market within the European Union (EU).

Generic EMC standards (or product standards i.e. product-family, or dedicated product standards where appropriate) define the emission and immunity test requirements presumed to satisfy the essential requirements of the EMC Directive.

It is recommended that this CENELEC Guide be read in conjunction with IEC Guide 107:1998-01 entitled ”Electromagnetic compatibility - Guide to the drafting of electromagnetic compatibility publications”.

Note: The present CENELEC Guide is based on the original first version of R110-001 (March 1993), with extensive updating to take into account the experiences gained within TC210 and the publication of additional EMC standards.

1. PURPOSE

The purpose of this Guide is to:

- advise on the application of the generic and basic EMC standards,
- advise on the preparation of product i.e. product-family or dedicated product EMC standards.

It should be noted that certification (*) aspects are not considered in this Guide.

This Guide is primarily intended for product oriented committees preparing EMC standards, especially in the field of immunity.

(*) N*ote: Certification (of conformity) is the action by a third party demonstrating that adequate confidence is provided that a duly identified product, process or service is in conformity with a standard or with other normative documents*

2. CHARACTERISTICS OF EMC STANDARDS

To fulfil the tasks related to meeting the requirements of the EMC Directive, it is essential to be able to distinguish between the 3 following types of EMC standards

a) basic standards,

b) generic standards,

c) product standards : including product-family standards and dedicated product standards.

The following sub-clauses define (as precisely as practicable) the characteristics of these different types of standards. (A list of basic and generic standards is given in Annex A.)

In addition to the above types of standards, there is a need for a further category of documents including guidance documents, codes of practice, etc.

Table 1 gives an overview of the characteristics of the different types of standards.

2.1. Basic EMC standards

Two types of basic EMC standards have been identified:
- those for tests and measurements
- those related to other aspects.

Basic standards for test and measurement are of particular importance in connection with generic and product standards for conformity assessment purposes.

a) Basic standards for emission and immunity tests and measurements

Contents

These standards give (often separately for each disturbing phenomenon) a definition and description of the phenomenon, detailed test and measurement methods, test instrumentation and basic test set up.

Ranges of test levels (immunity) may be given with respect to the characteristics of measuring equipment or measuring methods.

These standards shall not include prescribed limits and shall not contain performance criteria (not even general-purpose performance criteria).

Aims and use

These standards constitute the foundation of EMC-standardisation by defining the detailed test and measurement methods.

It is intended that generic and product (- family) standards should make reference to the basic standards without repeating their detailed contents. As such, a declaration of conformity of products with the basic standards has no significance and therefore basic standards will not be included in the list of harmonised standards published in the Official Journal of the European Communities (OJEC). This OJEC list will indeed include only those standards permitting the direct presumption of conformity of products with the Directive, using article 10.1.

b) Other types of basic standards and documents

Other types of EMC standards and publications relating to other aspects may be identified as 'basic', in as much as they describe the fundamental elements of EMC. For example, they may concern:

- Specialized terminology. e.g. IEC 61000-5-1 (Technical report Type 3).

- Description and classification of environment, possibly including ranges of environmental and/or compatibility levels, thus constituting an important basis for establishing emission limits and immunity test levels. e.g. IEC 61000-2-5 (Technical report Type 2).

2.2. Generic EMC standards

Contents

These standards for emission and immunity define a set of precise EMC requirements (including limits) and indicate which standardised tests are applicable to those products intended to be used in a given environment

It is intended that generic standards should not include detailed test and measurement methods or test instrumentation but refer for that purpose to basic standards. Generic standards may contain, when necessary, additional information (e.g. choice of one method where several are included in a basic standard).

Generic immunity standards specify a limited number of essential tests, with the objective of achieving a technical/economical optimum, thus avoiding over specifying test requirements. This selection is very critical.

These limited test requirements for conformity with the EMC Directive do not preclude that equipment must be designed to operate normally in its intended EMC environment for all disturbing phenomena specified within this environment.

Generic immunity standards also include those performance criteria of general application which are associated with specific test levels.

Aims and use

Compliance with the normative part of these generic standards assures formal conformity of products with the essential requirements of the EMC Directive. The generic standards should be used when no corresponding product standards exist or are deemed necessary.

In addition, generic standards play an essential role in the co-ordination of product standards.

2.3. Product EMC standards

2.3.1. Product-family EMC standards (*)

Contents

The scopes of such standards indicate the particular product-family concerned; these may be broad or narrow.

Product-family standards define specific EMC requirements (immunity and emission) and precise tests for the products within their scopes.

(*) Note: A product-family covers products with differing detailed functions, but having some common general characteristics. The borderline with dedicated products may sometimes be imprecise as families may be very broad or narrow.

It is intended that:

- Product-family standards should not normally include detailed measurement methods or test instrumentation, but give reference to basic standards. In exceptional and justified cases, specific test methods or deviations from the tests in the basic standards may be necessary.

- Product-family standards include all necessary additional information for the reproducible testing of those products.

- The tests and limits in product-family standards should be co-ordinated with those in the generic standards. Where deviations are necessary, they shall be fully justified (**) and the rationale shall be indicated, preferably within the product-family standards. Deviations may concern the phenomena considered, additional tests or test levels.

(**) Note: CENELEC TC 210 in their overall EMC co-ordination role should be given the opportunity to comment on the proposed justification prior to the finalisation of the standard.

- Product-family standards include more specific and detailed performance criteria than generic standards.

Aims and use

For assessment of compliance with the EMC Directive, product-family standards take precedence over generic standards, either partially or totally according to the EMC domains covered.

It is recommended that an EMC product-family standard forms a separate publication, except when EMC requirements are of such a simple nature that they may be introduced in a product-family standard covering the performance characteristics. In this case the EMC clauses shall be clearly separated and identified.

In safety standards EMC clauses not directly related to safety should preferably not be included.

2.3.2 Dedicated product EMC standards

The same criteria as defined for product-family standards apply. However EMC requirements, instead of constituting separate standards, are frequently included within the general-purpose (performance characteristics) standards dedicated to those specific (dedicated) products. EMC clauses within these general-purpose standards shall be separated and shall be clearly identified. However, having separate EMC standards is to be preferred.

Regarding emission requirements: when a particular product is covered by a product-family standard, the preparation of a dedicated product standard is seldom justified. Deviations from the specified emission limits will be allowed only in

exceptional cases. CENELEC/TC 210 in its co-ordination role will consider any proposed deviations.

Product specific functional characteristics have to be taken into consideration when determining the product's immunity requirements. Dedicated product EMC standards or clauses shall give precise performance criteria.

These product standards are therefore in some cases justifiably different from product-family and generic standards, however they should remain coordinated with them.

Table 1: Structure of Standards

Type	Contents	Aims
BASIC (*)	- Measurement and test methods - Instrumentation - Test set-up - Ranges of test levels (immunity) - No limits/No performance criteria	- Reference documents - No conformance testing of products (Not published in the OJEC list)
GENERIC	- Precise and essential requirements (limits) for all products intended for use in each environment i.e. residential, commercial, light industry and industry -Refer to basic standards for measurement/test methods (no repetition) - General performance criteria	- Conformance testing of products (Published in the OJEC list) - Co-ordination tool for product (family) standards
PRODUCT-FAMILY	- EMC requirements for product-families - More detailed performance criteria - Specific test set-up etc. - Refer to basic standards for measurements/tests (no repetition)	- Conformance testing of products (Published in the OJEC list). - Precedence over generic standards but to be co-ordinated with them.
DEDICATED PRODUCT	- Same as for product-family but more specific.	- Same as for product-family but more specific. - Generally not needed for emission

(*) Note: refers to basic standards for tests and measurements. There are other types of basic EMC standards (see sub-clause 2.1.b).

3 FORMULATION OF PRODUCT (FAMILY) EMC STANDARDS

3.1 Electromagnetic phenomena for immunity

3.1.1 Conducted low frequency phenomena

- Slow variations of the supply voltage
- Harmonics, inter-harmonics
- Signalling on the mains supply
- Voltage fluctuations
- Voltage dips and interruptions
- Voltage unbalance
- Power frequency variations

- Induced low frequency voltages
- DC current or voltage in AC networks

3.1.2. Radiated low frequency field phenomena

- Magnetic fields (*)
- Electric fields (*)

(*) Note: continuous or transient

3.1.3. Conducted high frequency phenomena

- Induced continuous wave voltages or currents
- Unidirectional transients (**)
- Oscillatory transients (**)

3.1.4. Radiated high frequency field phenomena

- Magnetic fields
- Electric fields
- Electromagnetic fields:
  - continuous waves
  - transients (**)

(**) Note: single or repetitive

3.1.5 Electrostatic discharge phenomena (ESD)

3.2. Electromagnetic phenomena for emission

In principle, the same phenomena exist as listed in 3.1, but until now, emission limits in product families have been applied only to the following phenomena or effects:

- power supply harmonic currents,
- power supply currents resulting in voltage fluctuations,
- radio-interference (power supply, radiation, signalling wires, etc.).
- audio-frequency magnetic fields in special cases

Note: Radio-interference emission limits may provide an indirect limitation of transients.

In future other phenomena may be considered under emission limits, none are presently foreseen.

3.3. Drafting of a Product EMC standard

3.3.1. *General*

A product EMC Standard should, to the maximum possible extent, align with the applicable generic EMC Standards; if not, all deviations from the generic EMC standards shall be fully justified and the rationale shall be given, e.g. in a separate document or, preferably, in the introduction of the standard or in an informative annex to it.

Note: Dedicated product standards have the same criteria as defined for product-family standards. See Clause 2.3.2.

A product EMC standard should preferably refer to the applicable generic EMC standards, and shall define specific performance criteria for immunity tests.

Note: In addition it will probably be necessary to indicate how to apply the standard to the product (specific test set-up and procedure if needed).
New tests, which are not defined in the basic EMC standards, should be avoided as far as possible.

Product EMC standards can, for example, be created for the following reasons

a) Specific functional requirements, in particular for safety and performance.

b) Specific environments.

c) Phenomena not considered in the generic standards

Note: For those phenomena not explicitly covered by testing requirements, it is assumed, to avoid over testing, that the immunity of the equipment is in practice always sufficient, in its intended environment; particularly as defined by the compatibility levels for mains supply disturbances.
This above assumption should be explicitly stated in product and dedicated product standards if testing for immunity to all phenomena given in clause 3.1 is not required. This statement should never be interpreted as a request for additional testing to ensure presumption of conformity to the EMC Directive.

3.3.2 Special points to be considered

A product EMC standard should preferably be structured in the same manner as a generic EMC standard.

In particular, the following points should be considered:

a) Define the type of product(s) covered by the product EMC standard.

Note: It is important that the scope of products covered is very clearly defined.

b) Describe and define the product operating conditions, environment and special phenomena to be considered.

c) For phenomena covered by a generic EMC standard, a new test procedure and appropriate test level(s) may be produced only in justified cases in order to achieve an adequate level of compatibility.

d) Test methods should be described in detail only for those phenomena not covered by basic standards. Otherwise reference should be made to basic standards.

3.3.3 Reference to other standards

The principles outlined above presuppose a hierarchy of standards and an extensive use of reference to other EMC standards. For example, generic standards and product (-family) standards refer in principle to basic standards without reproducing the details. It is therefore necessary to define clearly the principles that may be used to make such references.

In order to comply with CENELEC procedures (see PNE rules 2.3.3.3.), it is acceptable to make reference in a standard to other standardisation documents in the two following ways:

a) Give reference only to officially approved documents e.g. IEC, CENELEC or ETSI standards, ITU-R, IEC or ITU-T recommendations. For basic standards it is strongly recommended to use undated references. In the framework of the EMC Directive, with its legal implications, it may however in some cases be permissible to indicate the date and edition of the reference document. Care should be taken to update these references in the future when it is technically necessary.

In cases where reference is made to unapproved standards (e.g. CD, CDV or FDIS documents still under consideration in IEC), the corresponding clauses should be shown as 'under consideration'. This will promote transparency to the users of the standard by giving them preliminary advanced information on the foreseen future developments.

b) If, however, normative use needs to be made of an unapproved reference document (e.g. IEC CD or CDV), this reference document, or the essential part of it, should be reproduced without change in full extent in a normative annex to the standard, giving complete reference to the original document.

This will permit National Committees to vote with adequate knowledge and will allow easy updating and later suppression of the annex once the definitive reference document has been approved.

3.4. Coordinating role of CENELEC TC 210 for product EMC standards.

The coherence of EMC standards is ensured in TC 210 by internal procedures comprising two main responsibilities:

- the responsibility for checking product standards during their preparation by Product Oriented Committees.

- the responsibility for giving recommendations to CENELEC CS on the advice to be Journal, and subsequently suitable for the presumption of conformity to directives, particularly the EMC Directive.

This task of co-ordination of the product standards has been delegated by CENELEC/TC210 to the Standards Overview Group (SOG) of CENELEC/TC210 in order to assist the EMC Consultant designated by CENELEC BT.

ANNEX A

LIST OF GENERIC AND BASIC EMC STANDARDS

A.1 Generic standards

CENELEC/TC 210 is responsible for producing generic emission and immunity EMC standards for the following environments:

1 - Residential, commercial and light industrial
EN 50081-1 Generic emission standard.
EN 50082-1 Generic immunity standard.

2 - Industrial
EN 50081-2 Generic emission standard.
EN 50082-2 Generic immunity standard.

Note: European harmonised generic standards will be identical to IEC generic standards in future; this implies a change in numbering (e.g. EN 61000-6-2 will replace EN 50082-2)

A.2 Basic emission standards for test and measurement

Currently, no complete basic emission standards (fully in accord with the definitions given in this document) are readily available, but measurement and test methods are described in the following stand-alone product-family standards. Reference can be made to the appropriate clauses of these for measurement and test methods:

- Emission of harmonics of power frequency on mains supply (EN 61000-3-2)
- Emission of voltage fluctuations (Flicker) on mains supply (EN 61000-3-3)
- Emission of signalling on low-voltage electrical installations (EN 50065-1)
- Emission of conducted and radiated radio frequency disturbances (EN 55022 + EN 55014 for Discontinuous Disturbances)
  Emission of conducted and radiated radio-frequency disturbances (EN 55011)

Notes:

(1) EN 55011, EN 55013, EN 55014, EN 55022 and EN 61000-3-2 and -3 have at present a mixed character of basic and product-family standards (being stand alone documents). They are considered essentially as product-family standards, as their main purpose with regard to the EMC Directive is to ensure compliance for products.

(2) CISPR 16 is a basic standard for radio-interference measurements. IEC 61000-4-7 is a basic standard defining instrumentation for mains harmonics measurement, whereas IEC 61000-4-15 defines instrumentation for flicker measurements (standard flickermeter).

A.3 Basic immunity standards for test and measurement

At present, relevant reference standards for the following environmental phenomena exist:

-	Electrostatic discharge (ESD)	IEC 61000-4-2	EN 61000-4-2
-	Radio-frequency electromagnetic field	IEC 61000-4-3	EN 61000-4-3
-	Electrical fast transients/burst	IEC 61000-4-4	EN 61000-4-4
-	Surges	IEC 61000-4-5	EN 61000-4-5
-	Conducted high frequency disturbances	IEC 61000-4-6	EN 61000-4-6
-	Power-frequency magnetic fields	IEC 61000-4-8	EN 61000-4-8
-	Pulse magnetic fields	IEC 61000-4-9	EN 61000-4-9
-	Damped oscillatory magnetic fields	IEC 61000-4-10	EN 61000-4-10
-	Voltage variations, dips and interruptions	IEC 61000-4-11	EN 61000-4-11
-	Oscillatory waves	IEC 61000-4-12	EN 61000-4-12
-	Voltage fluctuations	IEC 61000-4-14	EN 61000-4-14
-	Conducted low-frequency disturbances	IEC 61000-4-16	EN 61000-4-16

Reference standards are in progress for the following environmental phenomena:

- harmonics and other low-frequency disturbances, ripple on DC supply etc.

Note: Short descriptions of all these and other tests and their references are gathered in the over view document IEC 61000-4-1 which gives useful information on the applicability of basic standards. Obviously, every basic standard is not intended to be called up for testing all products or for all conditions of use. Some basic standards have a very specific purpose.

ANNEX *B*

DEFINITIONS

For the purposes of this guide, the following definitions taken from IEC Guide 107, and also from IEC 60050(161) apply.

1 **electromagnetic environment**
the totality of electromagnetic phenomena existing at a given location
[IEV 161 -01 –011]

2 **electromagnetic disturbance**
an electromagnetic phenomenon which may degrade the performance of a device, equipment or system, or adversely affect living or inert matter

NOTE - An electromagnetic disturbance may be ***electromagnetic noise,*** *an* ***unwanted signal*** *or a change in the propagation medium itself. [IEV 161-01-051]*

3 **electromagnetic interference; EMI** (abbreviation)
degradation of the performance of an equipment, transmission channel or system caused by an **electromagnetic disturbance**

NOTES:
1 The English words "interference" and "disturbance" are often used indiscriminately.
2 In French, the term "perturbation electromagnétique" is also used with the meaning of "brouillage electromagnétique" *[IEV 161-01-06]*

4 **electromagnetic compatibility; EMC** (abbreviation)
ability of an equipment or system to function satisfactorily in its **electromagnetic environment** without introducing intolerable **electromagnetic disturbances** to anything in that environment [IEV 161-01-071]

5 **(electromagnetic) emission**
phenomenon by which electromagnetic energy emanates from a source
[IEV 161-01-08]

6 **immunity (to a disturbance)**
ability of a device, equipment or system to perform without degradation in the presence of an **electromagnetic disturbance** [IEV 161-01-20]

7 **high frequency**
frequency above 9 kHz

8 **low frequency**
frequency up to and including 9 kHz

9 port

particular interface of the equipment which couples this equipment with or is influenced by the external electromagnetic environment

The ports of interest are shown in figure 1. The enclosure port is the physical boundary of the apparatus (e.g. enclosure). The enclosure port provides for radiated and electrostatic discharge (ESD) energy transfer, whereas the other ports provide for conducted energy transfer.

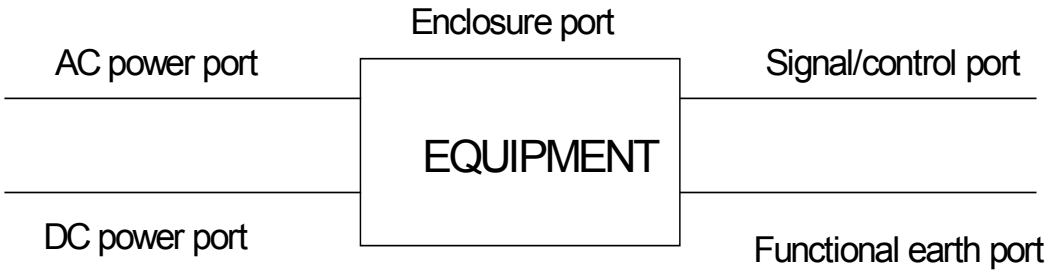

Figure 1 - Equipment ports

ANNEX C

GUIDELINE TABLE FOR COMPARING GENERIC AND PRODUCT STANDARDS

ANNEX C 1: Emission

Evaluation table, emission requirements

This table shall be used for checking alignment between the limits stated in the generic standards and in any other standard considered for publication in the Official Journal with reference to the EMC Directive 89/336/EEC.

	1. Equal to or more stringent limits Yes/No	2. Less stringent limits Value	3. Justification Yes/No	Column 1 or 2 & 3 combined acceptable Yes/No
Radiated, Enclosure				
Class A: 30-230 MHz, 30dBµV/m, 30m 230-1000MHz 37dBµV/m, 30m				
Class B: 30-230 MHz, 30dBµV/m,10m 230-1000MHz, 37dBµV/m, 10m				
Conducted **AC Mains port**				

Class A: 0,15 – 0.5 MHz 79dBµV QP 66dBµV AV 0,5 - 5 MHz 73dBµV QP 60dBµV AV 5 – 30 MHz 73dBµV QP 60dBµV AV				
Class B: 0,15 – 0,5 MHz 66-56dBµV QP 56-46dBµV AV 0,5 – 5 MHz 56dBµV QP 46dBµV AV 5 – 30 MHz 60dBµV QP 50dBµV AV				
0,15MHz – 30MHz EN 55014 discontinuous interference				
EN 61000-3-2 if applicable EN 61000-3-3 if applicable				

The locations - where the product encompassed by the standard may be used - shall correlate with the classification of Class A and Class B equipment, as given in CISPR standards

ANNEX C

GUIDELINE TABLE FOR COMPARING GENERIC AND PRODUCT STANDARDS

ANNEX C 2: Immunity

Evaluation table, immunity requirements

This table shall be used for checking alignment between the limits stated in the generic standards and in any other standard considered for publication in the Official Journal with reference to the EMC Directive 89/336/EEC.

	1. Equal to or more stringent limits Yes/No	2. Less stringent limits Value	3. Justification Yes/No	Column 1 or 2 & 3 combined acceptable Yes/No
Enclosure				
Power frequency magnetic field				
Radio frequency electromagnetic field				
ESD				
Signal lines and data buses not involved in process control, etc.				
Conducted high frequency disturbances, common mode				
Fast transients				
Surges line to ground line to line				
Process, measurement and control lines, and long bus and control lines				
Conducted high frequency disturbances, common mode				

Fast transients				
Surges line to ground line to line				
DC input and DC output ports				
Conducted high frequency disturbances, common mode				
Fast transients				
Surges line to ground line to line				
Voltage dips				
AC input and AC output power ports				
Conducted high frequency disturbances, common mode				
Fast transients				
Surges line to ground line to line				
Voltage dips				
Voltage interruptions				
Low frequency harmonics				
Functional earth				
Conducted high frequency disturbances, common mode				
Fast transients				

Note: Generic standards do not distinguish between those signal lines involved in process control and those, which are not. However some product standards may introduce such a distinction.