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TECHNICAL REPORT

BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) – Part 3-14: Assessment of emission limits for harmonics, interharmonics, voltage fluctuations and unbalance for the connection of disturbing installations to LV power systems

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

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FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 61000-3-14, which is a technical report, has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms part 3-14 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

The first edition of this technical report has been harmonised with IEC/TR 61000-3-6, IEC/TR 61000-3-7 and IEC/TR 61000-3-13.

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

Enquiry draft	Report on voting
77A/741/DTR	77A/748/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.

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

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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 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).

ACKNOWLEDGEMENT

In 2002, the IEC subcommittee 77A made a request to Cigre study committee C4 and Cired study committee S2, to organize an appropriate technical forum (joint working group) whose main scope was to prepare, among other tasks, a technical report concerning emission limits for the connection of disturbing installations to LV public supply systems.

To this effect, joint working group CIGRE C4.103/ CIRED entitled ‘’*Emission Limits for Disturbing Installations*’’ was appointed in 2003. The working group held 11 formal meetings dedicated to the revision of IEC/TR 61000-3-6 and IEC/TR 61000-3-7, and the preparation of two other technical reports on emission limits for voltage unbalance (IEC/TR 61000-3-13) and emission limits for disturbing installations connected at LV (this report).

Subsequent endorsement of the report by IEC was the responsibility of SC 77A.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-14: Assessment of emission limits for harmonics, interharmonics, voltage fluctuations and unbalance for the connection of disturbing installations to LV power systems

1 Scope

This part of IEC 61000, which is informative in its nature, provides guidance on principles that can be used as the basis for determining the requirements for the connection of disturbing installations to low voltage (LV) public power systems. For the purposes of this part of IEC 61000, a disturbing installation means an installation (which may be a load or a generator) that produces disturbances: harmonics and/or interharmonics, voltage flicker and/or rapid voltage changes, and/or voltage unbalance. The primary objective is to provide guidance to system operators or owners for engineering practices, which will facilitate the provision of adequate service quality for all connected customer installations. In addressing installations, this report is not intended to replace equipment standards for emission limits.

NOTE 1 In this report, low voltage (LV) refers to $U_n \leq 1$ kV.

This report addresses the allocation of the capacity of the system to absorb disturbances. It does not address how to mitigate disturbances, nor does it address how the capacity of the system can be increased.

This technical report only applies to installations connected to LV public power systems that supply or may supply other LV loads or installations. It is intended to apply to large installations exceeding a minimum size. This minimum size (S_{min}) is to be specified by the system operator or owner depending on the system characteristics.

NOTE 2 Due to this minimum size, this report generally does not apply to residential customer's installations.

This technical report is not intended to set emission limits for individual pieces of equipment connected to LV systems. The emission limits for LV equipment are specified in the applicable IEC product family standards. The limits specified in these standards have been determined based on assumptions of the number, type and usage of equipment producing disturbances in an installation connected to a supply system and based on the reference impedance given in IEC 60725 considered to be representative of the source impedance for small residential installations. The assumptions may not apply to larger LV installations. Hence, the guidelines in this report are intended to provide methods for developing emission limits for such large installations.

NOTE 3 Compliance with emission limits determined by application of the methods in this report does not preclude any requirement to comply with equipment emission limits (as determined by national or regional regulatory requirements.

This technical report deals with low-frequency conducted disturbances emitted by LV installations. The disturbances considered are:

– harmonics and interharmonics;
– flicker and rapid voltage changes;
– unbalance (negative-sequence component).

Since the guidelines outlined in this report are necessarily based on certain simplifying assumptions, there is no guarantee that this approach will always provide the optimum solution for all situations. The recommended approach should be used with flexibility and

judgment as far as engineering is concerned, when applying the given assessment procedures in full or in part.

The system operator or owner is responsible for specifying requirements for the connection of disturbing installations to the system. The disturbing installation is to be understood as the customer's complete installation (i.e. including disturbing and non-disturbing parts).

This report provides recommended procedures for developing emission limits for large LV installations. In order for any network operator or owner to fully apply this report, an expert would need to derive appropriate factors for the specific types of LV networks operated.

NOTE 4 Simplification of emission limits by setting one set of tables for all LV networks may, in some cases, result in excessively conservative limits.

The main part of this report gives the general procedure to allocate emission limits for harmonics, voltage fluctuation and unbalance to large installations connected at LV.

Annexes to this report give additional information. In particular,

- Annex A gives a practical example of technical application at distribution expert level or national regulation level, in order to derive their own limits tailored on the specific characteristics of their networks from the general method.
- Annex B gives an example of practical application at distribution operator level for the connection of specific installations based on the local parameters of the LV network.
- Annex C and Annex D give details on the theoretical basis for the derivation and the understanding of the procedures in this report.

2 Normative references

The following referenced documents are indispensable for the application 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*
Amendment 1 (1997)
Amendment 2 (1998)

IEC/TR 60725, *Consideration of reference impedances and public supply network impedances for use in determining disturbance characteristics of electrical equipment having a rated current ≤75 A per phase*

IEC/TR 61000-2-1:1990, *Electromagnetic compatibility (EMC) – Part 2-1: Environment – Description of the environment – Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems*

IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase)*

IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection*

IEC/TR 61000-3-6:2008, *Electromagnetic compatibility (EMC) – Part 3-6: Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

IEC/TR 61000-3-7:2008, *Electromagnetic compatibility (EMC) – Part 3-7: Limits – Assessment of emission limits for the connection of fluctuating load installations to MV, HV and EHV power systems*

IEC 61000-3-11, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤75 A and subject to conditional connection*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase*

IEC/TR 61000-3-13:2008, *Electromagnetic compatibility (EMC) – Part 3-13: Limits – Assessment of emission limits for the connection of unbalanced installations to MV, HV and EHV power systems*

IEC 61000-4-15, *Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications*

3 Terms and definitions

For the purposes of this document, the following definitions apply as well as the definitions in IEC 60050(161).

3.1
95 % (99 %) probability weekly (daily) value
value that is not exceeded during 95 % (99 %) of the time over one week (day)

3.2
agreed power
value of the apparent power of the disturbing installation on which the customer and the system operator or owner agree. In the case of several points of connection, a different value may be defined for each connection point

3.3
customer
person, company or organisation that operates an installation connected to, or entitled to be connected to, a supply system by a system operator or owner

3.4
(electromagnetic) disturbance
any electromagnetic phenomenon which, by being present in the electromagnetic environment, can cause electrical equipment to devite from its intended performance

3.5
disturbance level
the amount or magnitude of an electromagnetic disturbance measured and evaluated in a specified way

3.6
disturbing installation
electrical installation as a whole (i.e. including disturbing and non-disturbing parts) which can cause a disturbance of the voltage or current into the supply system to which it is connected

NOTE For the purpose of this report, all references to disturbing installations not only include loads, but generating plants as well.

3.7
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

NOTE 1 Electromagnetic compatibility is a condition of the electromagnetic environment such that, for every phenomenon, the disturbance emission level is sufficiently low and immunity levels are sufficiently high so that all devices, equipment and systems operate as intended.

NOTE 2 Electromagnetic compatibility is achieved only if emission and immunity levels are controlled such that the immunity levels of the devices, equipment and systems at any location are not exceeded by the disturbance level at that location resulting from the cumulative emissions of all sources and other factors such as circuit impedances. Conventionally, compatibility is said to exist if the probability of the departure from intended performance is sufficiently low. See Clause 4 of IEC/TR 61000-2-1.

NOTE 3 Where the context requires it, compatibility may be understood to refer to a single disturbance or class of disturbances.

NOTE 4 Electromagnetic compatibility is a term used also to describe the field of study of the adverse electromagnetic effects which devices, equipment and systems undergo from each other or from electromagnetic phenomena.

3.8
(electromagnetic) compatibility level
specified electromagnetic disturbance level used as a reference level in a specified environment for co-ordination in the setting of emission and immunity limits

NOTE By convention, the compatibility level is chosen so that there is only a small probability (for example 5 %) that it will be exceeded by the actual disturbance level.

3.9
emission
phenomenon by which electromagnetic energy emanates from a source of electromagnetic disturbance

[IEC 60050-161:1990, 161-01-08 modified]

NOTE For the purpose of this report, emission refers to phenomena or conducted electromagnetic disturbances that can cause distortions, fluctuations or unbalance on the supply voltage.

3.10
emission level
level of a given electromagnetic disturbance emitted from a particular device, equipment, system or disturbing installation as a whole, assessed and measured in a specified manner

3.11
emission limit
maximum emission level specified for a particular device, equipment, system or disturbing installation as a whole

3.12
generating plant
any equipment that produces electricity together with any directly connected or associated equipment such as a unit transformer or converter

3.13
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

3.14
immunity level
maximum level of a given electromagnetic disturbance on a particular device, equipment or system for which it remains capable of operating with a declared degree of performance

3.15
installation size

3.15.1
large installation
installation with an agreed power greater than or equal to a value specified by the system operator or owner

NOTE This specified value is named S_{min} in this report.

3.15.2
small installation
installation with an agreed power lower than a value specified by the system operator or owner

NOTE This specified value is named S_{min} in this report.

3.16
normal operating conditions
operating conditions of the system or of the disturbing installation typically including all generation variations, load variations and reactive compensation or filter states (e.g. shunt capacitor states), planned outages and arrangements during maintenance and construction work, non-ideal operating conditions and normal contingencies under which the considered system or disturbing installation has been designed to operate

NOTE Normal system operating conditions typically exclude: conditions arising as a result of a fault or a combination of faults beyond that planned for under the system security standard, exceptional situations and unavoidable circumstances (for example: force majeure, exceptional weather conditions and other natural disasters, acts by public authorities, industrial actions), cases where system users significantly exceed their emission limits or do not comply with the connection requirements, and temporary generation or supply arrangements adopted to maintain supply to customers during maintenance or construction work, where otherwise supply would be interrupted.

3.17
planning level
level of a particular disturbance in a particular environment, adopted as a reference value for the limits to be set for the emissions from the installations in a particular system, in order to co-ordinate those limits with all the limits adopted for equipment and installations intended to be connected to the power supply system

NOTE Planning levels are considered internal quality objectives to be specified at a local level by those responsible for planning and operating the power supply system in the relevant area.

3.18
point of common coupling
PCC
point in the public supply system, which is electrically closest to the installation concerned, at which other installations are, or could be, connected. The PCC is a point located upstream of the considered installation

NOTE A supply system is considered as being public in relation to its use, and not its ownership.

3.19
point of connection
POC
point on a public power supply system where the installation under consideration is, or can be connected