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English Version

Study Report on Electromagnetic Interference between Electrical Equipment/Systems in the Frequency Range Below 150 kHz

Rapport d'étude sur les perturbations électromagnétiques entre les équipements / systèmes électriques entre eux dans la plage des fréquences inférieure à 150 kHZ

Studienbericht über elektromagnetische Interferenz zwischen elektrische Betriebsmittel/Systeme im Frequenzbereich unter 150 kHz

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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European foreword

This document (CLC/TR 50627:2015) has been prepared by CLC/SC 205A "Mains communicating systems".

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

This Technical Report provides useful information for standards related to the following European Mandate(s): M/441, M/490.

This Technical Report is based on the Study Report “Electromagnetic Interference between Electrical Equipment / Systems in the Frequency Range below 150 kHz” of SC 205A (SC 205A/Sec0339/R:April 2013) (second edition) [1b], with some update according to the developments that have taken place since.

Introduction

In April 2010, CLC/SC 205A[1)] published their first Study Report on “Electromagnetic Interference between Electrical Equipment in the Frequency Range below 150 kHz” [1a]. Related studies had been made and information gathered due to first cases of EM interference, with Touch-dimmer lamps (TDLs) as an EMI victim, an inverter as an EMI source, and automated meter reading systems using powerline communication (AMR-PLC) figuring as EMI victims as well as sources.

Following this first CLC/SC 205A Study Report, its second edition [1b] and, based on it, this Technical Report aims at:

a) highlighting the broad relevance of recognized electromagnetic interference for safeguarding EMC also in the frequency range 2 kHz – 150 kHz;

b) extending knowledge about:

1) EMI cases having been observed between electrical equipment in the frequency range 2 kHz to 150 kHz, with an emphasis on interference between:

i) electrical equipment and its non-intentional emissions (NIE);

ii) mains communicating systems (MCS) using (powerline communication) PLC technology with intentional signal injection for the transmission of information over the electricity supply network;

2) different mechanisms causing interference to electrical equipment due to non-intentional or intentional voltage/current components in the considered frequency range;

as a basis for evaluating the need for closing the recognized gap in standardization as highlighted in the first edition, and considering the recent developments; that:

c) without evaluating certain types of electrical equipment concerning applied technology or priority;

d) and with regard to:

1) problems having occurred with operational equipment of distribution network operators (DNOs), in particular related to smart metering and smart grids control and monitoring equipment;

2) complaints by network users to deliverers and subsequently by deliverers to DNOs or by network users directly to their DNO, about degradation or loss of function of certain electrical equipment;

3) in both cases network users as well as deliverers are primarily annoyed by the troubles they are experiencing with electrical equipment they have traded or bought, trusting in its interference-free operability, which they expect due to the CE mark.

This TR is based on:

e) reports on EMI cases and, following related complaints, investigations performed by an accredited test house, universities, DNOs, manufacturers and consultants;

f) measurements performed by an accredited test house, universities, DNOs, manufacturers and consultants. In both cases to extend knowledge of emissions from different equipment in the considered frequency range, in case of the occurrence of EMI:

1) to identify the actual interference source;

2) to clarify the interference mechanism;

3) to evaluate mitigation measures;

g) the present standardization situation and its actual development.

1) CLC/SC 205A Mains communicating systems.

1 Scope

This Technical Report is based on two Study Reports of CLC/SC 205A, having been worked out by their Task Force EMI [1a][1b] and provides the results and findings of these documents. It was created with the help and input from a broad range of involved stakeholders: network operators, equipment manufacturers, universities, accredited test houses and consultants.

Beside the actual standardization situation it reflects the current emission situation found in supply networks and installations and describes electromagnetic interference (EMI) cases from twelve countries; investigation and analysis of the latter show a wide range of different types of electrical devices to be considered as a source or a victim of related EMI.

This Technical Report highlights the occurrence of high levels of non-intentional emissions (NIE) in the considered frequency range, including values up to and exceeding the standardized limits for intentional signals from mains communicating systems (MCS), which also implies a high potential to cause EMI to other electrical equipment. On the other hand, several types of equipment show susceptibility to related emissions, being insufficiently immune.

The Technical Report addresses the following issues:

- a number of different types of electrical equipment are generating such emissions and/or are susceptible, to such, thus representing EMI potential, as a source or a victim of such EMI;
- the interaction of electrical equipment in a certain supply area respectively installation, with its complex and volatile impedance character, as having an additional EMI potential; that besides NIE from general electrical equipment and signals from MCS and technically being quite different from emissions;
- the fact that besides the conducted interference also radiated interference from NIE or signals from MCS, through the magnetic H-field following to related currents on the mains, is to be considered, what is of some importance also for the interference-free operation of broadcast time-signal systems or electronic circuits controlled by such;
- the ageing of electronic components in electric equipment, which causes increased emissions and EMI to other electrical equipment as a result of not showing the same EMC characteristics as before being placed on the market, therefore no longer being able to conform with EMC requirements;
- the additional aspect of differential mode operation, which should be considered for related immunity and testing specifications.

These findings confirm that EMI in this frequency range is not limited to single types of equipment like inverters or MCS; instead a more general electromagnetic compatibility (EMC) problem concerning a larger spectrum of electrical equipment is identified.

Although a case-by-case mitigation of related EMI cases might be seen as appropriate, the increasing application of technologies and systems with related EMI potential requires a more general solution, through standardization, taking a balanced viewpoint of EMC and economics into account. With regard to the actual standardization situation, a review of the actual EMC and Product standards based on the reported results seems to be advisable.

After initiating the work in CLC/SC 205A, the now ongoing work in IEC SC 77A, as well as the publication of a related Technical Report on testing electricity meters [2] by CLC/TC 13 and of the new Immunity testing standard EN 61000-4-19 [99], appear as right steps into the right direction but needing further, extended efforts.

As stated on European as well as on international EMC standardization level, the availability of compatibility levels for the considered frequency range appears as a key-requirement for future considerations on setting related emission limits and immunity requirements in various standards. A fundamental basis for the co-existence of intentional signals from MCS and NIE needs to be found.

2 General

When talking about EMI in the frequency range 2 kHz to 150 kHz it is appropriate to highlight the development of electricity application respectively the use of the electricity supply network during the past decades, which is characteristic for the today's given situation; this development has led to: