



SLOVENSKI STANDARD

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Guide for the evaluation of electromagnetic fields around power transformers

Guide for the evaluation of electromagnetic fields around power transformers

Leitfaden für die Bewertung von elektromagnetischen Feldern in der Umgebung von Leistungstransformatoren

Guide pour l'évaluation des champs électromagnétiques autour des transformateurs de puissance

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Ta slovenski standard je istoveten z: **R014-001:1999**

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CENELEC

R014-001

REPORT

May 1999

English version

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This CENELEC Report has been prepared by the Technical Committee CENELEC TC 14, Power transformers. It was approved by the Technical Committee on 1998-10-12 and endorsed by the CENELEC Technical Board on 1999-04-01.

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.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This CENELEC Report was prepared by the Technical Committee CENELEC TC 14, Power Transformers.

It was submitted on 1998-10-12 to the approval of the National Committees of CENELEC in writing under the Secretariat Enquiry CLC/TC14(SEC)248 (expiring on 1998-12-31) and no National Committee expressed disagreement on it.

The Technical Board of CENELEC authorized its publication on 1999-04-01.

Annexes A and B provide additional information.

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Introduction

EMC is covered by three kinds of standardisation documents :

- Basic Standard :

Basic Standards are mainly informative documents covering disturbance phenomena, disturbance levels and test and measurement techniques. For example, EN 61000/IEC 61000 is a Basic Standard.

- Generic Standard :

Generic Standard are intended to cover a range of products for which no Product Standard exists. For example, EN 50081-1 and EN 50081-2, EN 50082-1 and EN 50082-2 are Generic Standards.

- Product Standards :

Product Standards are intended to deal with a specific family of electrical or electronic equipment.

Power transformers however, are considered as passive equipment and as such, the above referenced documents are not applicable.

This Report is intended to give guidance on EMC phenomena associated with power transformers.

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1 Scope

This Report provides guidance for the evaluation of electromagnetic fields around power transformers.

This Report applies to power transformers covered by EN 60076 (HD 398) series and HD 464 with the following characteristics :

- apparent rating P : $5 \text{ kVA} \leq P \leq 1000 \text{ MVA}$
- insulating level, according to HD 398.3 :
 - high voltage winding : U_m from 7,2 kV to 525 kV
 - low voltage winding : U_m up to 525 kV

Reactors are excluded from the present Report.

Continuous conducted and radiated emissions are considered for power transformers operating under nominal working conditions of voltage and current.

Fault conditions and low occurrence transient events, such as :

- short-circuits,
- lightning and switching transients,
- overloads (inrush currents,...),
- overvoltages,
- tap-changer operations,

are not considered as normal working conditions.

Immunity conditions are considered to ensure the power transformer operates as intended in its normal working environment. The immunity capability of the power transformer is considered for steady state and transient working conditions.

2 References

This Report incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Report only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50081-1	1992	Electromagnetic compatibility - Generic emission standard - Part 1 : Residential, commercial and light industry
EN 50081-2	1992	Part 2 : Industrial environment
EN 50082-1	1992	Electromagnetic compatibility - Generic immunity standard - Part 1 : Residential, commercial and light industry

EN 50082-2	1995	Part 2 : Industrial environment
EN 60076 HD 398	series	Power transformers (IEC 60076 series)
EN 61000	series	Electromagnetic compatibility (IEC 61000 series)
HD 428	series	Three-phase oil immersed distribution transformers 50 Hz, from 50 to 2500 kVA with highest voltage for equipment not exceeding 36 kV
HD 464 S1 + A2 + A3 + A4	1988 1991 1992 1995	Dry type power transformers (IEC 60726:1982 + A1:1986, mod.)
HD 538	series	Three-phase dry-type distribution transformers 50 Hz, from 100 to 2500 kVA with highest voltage for equipment not exceeding 36 kV
IEC 60050(161)	1990	International Electrotechnical Vocabulary Chapter 161 : Electromagnetic Compatibility (standards.iteh.ai)
CISPR 16-1	1993	Specification for radio disturbance immunity measuring apparatus and methods -- Part 1 : Radio disturbance and immunity measuring apparatus https://standards.iteh.ai/catalog/standards/sist/8567b9ee-d4c1-4042-b0d1-84944c257c0/sist-1014-001-2001
CISPR 18	series	Radio interference characteristics of overhead power lines high voltage equipment

3 Definitions

The definitions quoted in IEC 60050(161), in EN 60076 (HD 398) series as well as those mentioned in the above referenced standards apply.

4 Emission

4.1 Radiated emission

4.1.1 Power frequency magnetic field

The most significant value of the power frequency magnetic field is due to the current flowing in the LV terminals. The magnetic field of the transformer, produced by the currents flowing in the windings, can be neglected.

The power frequency magnetic field radiated by a transformer without enclosure along its lateral faces has the same order of magnitude as the field radiated by the currents flowing in the LV terminals.

The effect of this field can be reduced by providing a suitable enclosure or shielding.

As a guide, magnetic fields from simple busbar arrangements can be calculated to provide approximate values for the transformer environment, as illustrated in annex A.

4.1.2 Power frequency electric field

The electric field is produced by the energized conductors. The magnitude of the electric field in space is proportional to the voltage level and is highly dependent on the position and shape of the other conducting objects (energized or grounded) in the close environment.

Except for some special dry type transformers without an enclosure, the electric radiated field is only significantly produced by the busbars and terminals.

For liquid immersed transformers supplied by screened cables (e.g. oil immersed with plug-in bushings) and dry type transformers in enclosure, the electric field is negligible.

As a guide, electric fields from simple busbar arrangements can be calculated to provide approximate values for the transformer environment, as illustrated in annex B.

4.1.3 Radio frequency fields (corona effect)

The main source of field is due to corona and partial discharges from high voltage busbar connections and surface partial discharges on the bushings. The source of radio frequency field from the inner parts of the transformer is negligible in comparison. The dominant radio frequency field is determined by external factors and not by the transformer.

NOTE: CISPR 16-1 describes measurement techniques and CISPR 18 gives some typical levels found near overhead lines and other high voltage equipment.

4.2 Conducted emission

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4.2.1 Harmonics of no-load current

The no-load current and the harmonics of the no-load current are significantly lower than the nominal current, except for some special designs.

Purchaser specifications may contain requirements.

5 Immunity

Control devices of transformers should be suitable to operate correctly in electromagnetic environment, according the relevant standards (see note in 5.1).

5.1 Radiated disturbances

Transformers are not generally sensitive to radiated magnetic, electric or electromagnetic fields.

NOTE: Cases of maloperation due to radiated disturbances are known. It was found that the transient magnetic field under short circuit conditions could operate Buchholz relays of the magnetic reed type. This problem can be overcome with suitable shielding.

5.2 Conducted disturbances

Power transformers may be subjected to the following conducted disturbances :

- network voltage fluctuations;
- frequency variations;
- voltage harmonics;