DRAFT FOR DEVELOPMENT

DD CLC/TS 50217:2005

Guide for in situ measurements — In situ measurement of disturbance emission

ICS 29.02

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It is being issued in the Draft for Development series of publications and is of a provisional nature because it provides the methodology for taking measurements rather than setting detailed requirements and it is intended for investigations rather than conformity assessment. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

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Cross-references

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Guide pour mesures in situ – Mesure in situ des émissions perturbatrices

Leitfaden für Messungen am Aufstellungsort – Störaussendungsmessungen am Aufstellungsort

This Technical Specification was approved by CENELEC on 2004-07-31.

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European Committee for Electrotechnical Standardization
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Foreword

This Technical Specification was prepared by the Technical Committee CENELEC TC 210, Electromagnetic compatibility (EMC).

The text of the draft was submitted to the vote and was approved by CENELEC as CLC/TS 50217 on 2004-07-31.

The following date was fixed:

– latest date by which the existence of the CLC/TS has to be announced at national level (doa) 2005-11-11

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1 Scope

This guide describes analysis methods of disturbance emission to be applied in situ for identification of the disturbance source and resolution of complaint. Where applicable, the methods rely on already published documents either in CENELEC or in IEC. It is not intended to be used for type testing or any kind of conformity assessment.

Dealing with effects on living matter is excluded from this document.

The frequency range of interest is from d.c. to 400 GHz.

This document applies for analysing an interference complaint. It provides method for identification and characterisation in situ of the source(s) of interference. It proposes procedures to discriminate different kind of sources. Reference in situ measurement distances are defined. It allows comparison of the results and of technical characteristics of the interfered equipment with existing relevant standards. The result of the comparison is intended to help in the resolution of the complaint.

It is meant for verifying the emissions from fixed installations whatever equipment they contain, and whatever have been the type tests of these equipment. It may be used to describe the coupling path for interference between the victim and the source, and to compare the measurement results with the limits from the adequate standard, at a specific location and in a given frequency band.

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.

EN 55011:1998, *Industrial, scientific and medical (ISM) radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement* (CISPR 11:1997, mod.) [dow: 2001-01-01]

EN 55011:1998/A1:1999 (CISPR 11:1997/A1:1999) [dow: 2002-08-01]

EN 55011:1998/A2:2002 (CISPR 11:1997/A2:2002) [dow: 2005-10-01]

EN 55016-1-X, series, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-X: Radio disturbance and immunity measuring apparatus* (CISPR 16-1-X, series) [dow: 2007-09-01]

EN 55016-1-2:2004, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances* (CISPR 16-1-2:2003) [dow: 2007-09-01]

EN 55016-1-2:2004/A1:2005 (CISPR 16-1-2:2003/A1:2004) [dow: 2008-02-01]

EN 55016-2-X, series, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-X: Methods of measurement of disturbances and immunity* (CISPR 16-2-X, series) [dow: 2007-09-01]

EN 55016-2-1:2004, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-X: Methods of measurement of disturbances and immunity - Conducted disturbance measurements* (CISPR 16-2-1:2003) [dow: 2007-09-01]

EN 55016-2-1:2004/A1:2005 (CISPR 16-2-1:2003/A1:2005) [dow: 2008-08-01]

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EN 55022:1998 + corrigendum July 2003, *Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement* (CISPR 22:1997, mod.) [dow: 2005-08-01]

EN 55022:1998/A1:2000 + corrigendum April 2003 (CISPR 22:1997/A1:2000) [dow: 2005-08-01]

EN 55022:1998/A2:2003 (CISPR 22:1997/A2:2002) [dow: 2005-12-01]

EN 61000-2-4:2002, *Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances* (IEC 61000-2-4:2002) [dow: 2005-09-01]

ETSI EN 300 386:2001, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements*

CISPR 18-2:1986, *Radio interference characteristics of overhead power lines and high-voltage equipment - Part 2: Methods of measurement and procedure for determining limits*

CISPR 18-2:1986/A1:1993

CISPR 18-2:1986/A2:1996

NOTE See also the bibliography.

3 Definitions - Terms and abbreviations

For the purpose of this document, the following definitions as well as the definitions of IEC 60050-161 apply, see particularly electromagnetic disturbance (161-01-05) and electromagnetic interference (161-01-06).

3.1
AMN
Artificial Mains Network

3.2
antenna reference point
geometric centre of the antenna or the reference point referred to in the antenna calibration procedure

3.3
characterised interference
interference the origin of which is an identified electromagnetic phenomena, and for which the disturbance level at a given point is characterised by a collection of technical data for example the spectrum

3.4
deviation from intended use regarding EMC
installation and/or operation of a device, equipment or system, deviating from the instructions of the manufacturer given in the user's manual

NOTE The installation refers to both the defined environment and electrical conditions including cabling.

3.5
distribution point
point on a data and communication network inside a system or an installation, electrically nearest to a particular communication equipment or terminal, at which other equipment or terminals are, or could be, connected

3.6
fixed installation
a particular combination of several types of apparatus and, where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location

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3.7
in-plant point of coupling (IPC)
point on a network inside a system or an installation, electrically nearest to a particular load, at which other loads are, or could be, connected [EN 61000-2-4]

NOTE The IPC is usually the point for which electromagnetic compatibility is to be considered.

3.8
point of common coupling (PCC)
point on a public power supply network, electrically nearest to a particular load, at which other loads are, or could be, connected [IEV 161-07-15, modified, EN 61000-2-4]

3.9
reference distance (for in situ measurement)
distance at which in situ measurement is performed in case of complaint, it is measured along a perpendicular line from the antenna reference point to a surface

NOTE 1 Two different values are defined according to the frequency range.

NOTE 2 The surface for measurement depends on different conditions.

3.10
system
set of interrelated elements considered in a defined context as a whole and separated from their environment [IEV 351-11-01]

NOTE 1 Such elements may be both material objects and concepts as well as the results thereof (e.g. forms of organisation, mathematical methods, programming languages).

NOTE 2 The system is considered to be separated from the environment and from the other external systems by an imaginary surface, which cuts the links between them and the system.

NOTE 3 For the purpose of this standard, the elements of the system are material objects: devices, equipment or sub-systems. They are interrelated for achieving an objective which is the performance of a function or a set of functions.

3.11
victim
interfered equipment having caused the complaint

4 Overview of the methodology

4.1 Measurement techniques

4.1.1 General

According to the established and standardised practice Figure 1 summarises the methods of measurement depending on the frequencies investigated.

The three frequency bands make the fundamental distinction to allow the analysis of the disturbance emission and the identification of the coupling path. They correspond to adapted measurement techniques.

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< 9 kHz	9 kHz to 30 MHz	> 30 MHz
– Voltage variations – Voltage dips and fluctuations – Harmonics and interharmonics – Magnetic field – Electric field	– Disturbance voltage – Disturbance current – Magnetic field – Electric field	– Electric field – Electromagnetic field
Measurement equipment – Mains analyser – Oscilloscope – Spectrum analyser – Magnetic probe – Electric probe – Adapted sensors	Measurement equipment – Receiver or spectrum analyser compliant with EN 55016-1 – Voltage probe – Current probe – Magnetic antenna – Electric antenna – Magnetic probe – Electric probe – Broadband isotropic probe – Adapted sensors	Measurement equipment – Receiver or spectrum analyser compliant with EN 55016-2 – Broadband antenna – Horn antenna – Broadband isotropic probe

Figure 1 – Overview of the in situ measurement techniques

A preliminary investigation should establish the frequencies to be measured: frequency of highest emission, frequency of interference in case of complaint, etc.

Measurement uncertainties are not taken into account for setting the results of measurement in situ.

4.1.2 Low frequency (below 9 kHz)

The effects of disturbance emission are predominantly due to

– conduction either by the supply system including the earth port, or by the different process control and/or signal ports,

– inductive coupling with a magnetic field,

– capacitive coupling with an electric field.

The state of the art of the measurement techniques do not allow today to identify in any circumstances the origin of the disturbance. Simulation techniques are a necessary complement to measurements to allow identification of the emitter. However, the simulation needs the knowledge of parameters and variables which can only be known by co-operation between the different parties, those operating the measurements, those operating the suspected emitter, and those operating the medium of which measurements are performed.

See Annex D for initial information.

4.1.3 High frequency (above 9 kHz)

The measurement receiver and the probes for measurement of conducted emission are defined in EN 55016-1. The measurement procedure is described in EN 55016-2, and also mentioned in EN 55011 and in EN 55022. Antennas are selected according to the frequency range, probes are selected according to the nature of the circuit:

- measurement on cables current probe (5.1 of EN 55016-1-2);
- measurement at terminals voltage probe (5.2 of EN 55016-1-2).

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For in situ measurement on the power supply network, the use of AMN is unlikely to be suitable, due to practical reasons for insertion, ratings, and safety considerations (leakage current). Moreover the purpose is to measure the actual conditions seen in situ. Therefore the recommendation is to measure

- the disturbance voltage (asymmetrical mode), without additional impedance,
- where the ambient noise or impedance conditions makes the result uncertain, the common mode current can be measured alternatively.

NOTE Special precautions need to be taken in the case of not neutral grounded power supply networks.

For in situ measurement on data and communication networks on dedicated wires, the purpose of measuring the actual conditions seen in situ is achieved by measurement of the common mode current.

The measurement receiver and the antennas for the measurement of radiated emissions are defined in EN 55016-1. The in situ measurement procedure is described in EN 55016-2. Antennas and detectors are selected according to the frequency band:

- below 30 MHz	loop antenna and QP detector; measurement of the magnetic field strength; short active dipole is used for measurement of electric field strength;
- between 30 MHz and 1 000 MHz	broadband antenna and QP detector; measurement of the electric field strength;
- above 1 GHz	double ridged wave-guide recommended, PK detector; measurement of the electric field strength.

Special conditions related to in situ measurements are developed in Clause 5.

Product related information are to be found in the relevant standard, examples: EN 55011 for ISM, EN 55022 for ITE, ETSI EN 300 386 for telecommunication network equipment, etc.

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4.2 Methodology in case of complaint

According to the whole purpose of the document, Figure 2 illustrates the method to investigate interference cases, see Annex A.

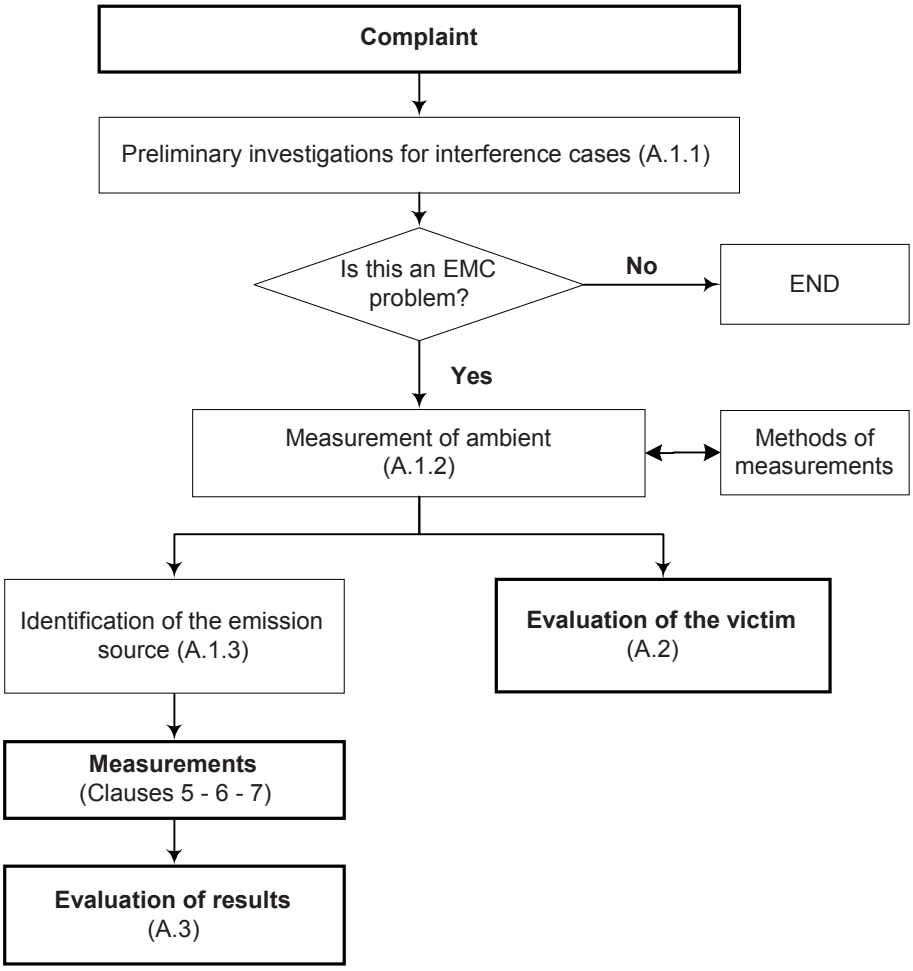

Figure 2 – Overview of the methodology in case of complaint

The preliminary investigation is necessary to give an efficient orientation to the search for the origin of the interference, including the recognition of the nature of the complaint due to EMC or not. The measurement of the ambient characteristics is the basis for any further analysis. From this knowledge, a decision can be made regarding the next step of investigation: either with the victim, or with an unknown source of emission.

Investigation on an unknown emission relies first on measurement in the vicinity of the interfered equipment (victim). The frequency and the direction of the highest field strength and/or the spectrum of the disturbance signal, correlated with the result of the preliminary investigation, are the main clues for localisation of the emitter of the disturbance.

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5 Selection of measurement location and general condition

5.1 General

Both radiated and conducted measurement follow the same principle, in order to characterise the source of emission.

The frequency to be analysed by measurement is defined according to the preliminary investigation.

The location of radiated emission measurement is defined to show the highest level of emission for a given frequency according to the purpose of the investigation, and according to local constraints. The procedure related to the highest emission is defined in EN 55016-2, and in case of interference see A.1.3.

The location of conducted emission measurement on the power supply network is the PC (IPC or PCC), in fact the nearest accessible point of the network.

The location of conducted emission measurement on data and communication network on dedicated wires is the next accessible distribution point.

The complete characterisation of the emitter could necessitate measurements inside the boundary of the installation where it is located (see 5.4). This is only possible if the person responsible for this installation agrees to such measurements.

5.2 Frequency range up to 30 MHz

For the measurement of voltage fluctuations, harmonic currents and voltages (up to order 40), the PC (point of coupling, either IPC or PCC), or the nearest accessible point from the PC, is used. The same point of measurement is used in the frequency range from harmonic order 40 (2 kHz) to 9 kHz. See more information in Clause D.2.

The conducted emission on data and communication network is measured in a distance of less than 1 m from the source of emission for disturbance current or at the next accessible distribution point.

If the magnetic field strength is measured, the reference distance shall be of 3 m from the next accessible surface of the network cable (see 3.9).

5.3 Frequency range above 30 MHz

5.3.1 Principle

For the measurement of the disturbance emission of a source of emission, the location for the measurement depends on the nature of the source, measured frequency range or the position of the interfering equipment. The measurement location is not necessarily the reference point of the disturbance limit.

5.3.2 Radiated emission from fixed installation

The location for the measurement is chosen taking into account the direction of the victim. The disturbance field strength of an installation is generally measured outside the building or at the border of the property (the surface for the reference distance is the outer fence, or outer wall of the building or flat in which the emission source is located). The reference distance shall be 10 m (see 3.9).

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