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COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

BASIC EMC PUBLICATION
PUBLICATION FONDAMENTALE EN CEM

**Specification for radio disturbance and immunity measuring apparatus and methods –
Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test
sites for radiated disturbance measurements**

**Spécifications des méthodes et des appareils de mesure des perturbations
radioélectriques et de l'immunité aux perturbations radioélectriques –
Partie 1-4: Appareils de mesure des perturbations radioélectriques et de l'immunité aux
perturbations radioélectriques – Antennes et emplacements d'essai pour les mesures
des perturbations rayonnées**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

**SPECIFICATION FOR RADIO DISTURBANCE AND IMMUNITY
MEASURING APPARATUS AND METHODS –**

**Part 1-4: Radio disturbance and immunity measuring apparatus –
Antennas and test sites for radiated disturbance measurements**

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This consolidated version of CISPR 16-1-4 consists of the third edition (2010) [documents CISPR/A/885/FDIS and CISPR/A/891/RVD], its amendment 1 (2012) [documents CISPR/A/995/FDIS and CISPR/A/1005/RVD] and its corrigendum of December 2010. It bears the edition number 3.1.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

International Standard CISPR 16-1-4 has been prepared by CISPR subcommittee A: Radio-interference measurements and statistical methods.

This edition includes the following significant technical change with respect to the previous edition: provisions are added to address evaluation of a set-up table in the frequency range above 1 GHz.

It has the status of a basic EMC publication in accordance with IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of CISPR 16 series, under the general title *Specification for radio disturbance and immunity measuring apparatus and methods*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendments 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

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INTRODUCTION (to Amendment 1)

This amendment introduces the Reference Site Method (RSM). In addition to introducing new content, Clause 5 is significantly restructured. To aid the reader in navigating this amendment, the following table provides a comparison of subclauses in the existing Edition 3.0 with those in this amendment. This introduction will be removed before the subsequent edition is published.

Comparison of Clause 5 between original Edition 3.0 and Amendment 1

Original Edition 3.0		Amendment 1	
5	Test sites for the measurement of radio disturbance field strength for the frequency range of 30 MHz to 1 000 MHz	5	Test sites for the measurement of radio disturbance field strength for the frequency range of 30 MHz to 1 000 MHz
5.1	General	5.1	General
5.2	OATS	5.2	OATS
5.2.1	General	5.2.1	General
5.2.2	Weather protection enclosure	5.2.2	Weather protection enclosure
5.2.3	Obstruction-free area	5.2.3	Obstruction-free area
5.2.4	Ambient radio frequency environment of a test site	5.2.4	Ambient radio frequency environment of a test site
5.2.5	Ground plane	5.2.5	Ground plane
5.2.6	OATS validation procedure		
5.3	Test site suitability for other ground-plane test sites	5.3	Suitability of other test sites
5.3.1	General	5.3.1	Other ground-plane test sites
5.3.2	Normalized site attenuation for alternative test sites	5.3.2	Test sites without ground plane (FAR)
5.3.3	Site attenuation		
5.3.4	Conducting ground plane		
5.4	Test site suitability without ground plane	5.4	Test site validation
5.4.1	Measurement considerations for free space test sites, as realized by fully-absorber-lined shielded enclosures	5.4.1	General
5.4.2	Site performance	5.4.2	Overview of test site validations
5.4.3	Site validation criteria	5.4.3	Principles and values of the NSA method for OATS and SAC
		5.4.4	Reference site method for OATS and SAC
		5.4.5	Validation of an OATS by the NSA method
		5.4.6	Validation of a weather-protection-enclosed OATS or a SAC
		5.4.7	Site validation for FARs
5.5	Evaluation of set-up table and antenna tower	5.5	Evaluation of set-up table and antenna tower
5.5.1	General	5.5.1	General
5.5.2	Evaluation procedure for set-up table influences	5.5.2	Evaluation procedure for set-up table influences

SPECIFICATION FOR RADIO DISTURBANCE AND IMMUNITY MEASURING APPARATUS AND METHODS –

Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements

1 Scope

This part of CISPR 16 specifies the characteristics and performance of equipment for the measurement of radiated disturbances in the frequency range 9 kHz to 18 GHz. Specifications for antennas and test sites are included.

NOTE In accordance with IEC Guide 107, CISPR 16-1-4 is a basic EMC publication for use by product committees of the IEC. As stated in Guide 107, product committees are responsible for determining the applicability of the EMC standard. CISPR and its sub-committees are prepared to co-operate with product committees in the evaluation of the value of particular EMC tests for specific products.

The requirements of this publication apply at all frequencies and for all levels of radiated disturbances within the CISPR indicating range of the measuring equipment.

Methods of measurement are covered in Part 2-3, and further information on radio disturbance is given in Part 3 of CISPR 16. Uncertainties, statistics and limit modelling are covered in Part 4 of CISPR 16.

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.

CISPR 16-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-5:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-5: Radio disturbance and immunity measuring apparatus – Antenna calibration test sites for 30 MHz to 1 000 MHz*

CISPR 16-2-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

~~CISPR/TR 16-3:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 3: CISPR technical reports*~~

~~Amendment 1(2005)~~

~~Amendment 2(2006)~~

CISPR 16-4-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements*

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply, as well as those of CISPR 16-1-1, CISPR 16-1-5, and IEC 60050-161.

3.1 Terms and definitions

3.1.1

antenna

that part of a transmitting or receiving system that is designed to radiate or to receive electromagnetic waves in a specified way

NOTE 1 In the context of this standard, the balun is a part of the antenna.

NOTE 2 This term covers various devices such as the wire antenna, free-space-resonant dipole, hybrid antenna and horn antenna.

3.1.2

balun

passive electrical network for the transformation from a balanced to an unbalanced transmission line or device or vice versa

3.1.3

calibration test site

CALTS

open area test site with metallic ground plane and tightly specified site attenuation performance in horizontal and vertical *E*-field (electric field) polarization

<https://standards.iteh.ai/en/standards/cispr/16-1-4-2010/618-b08c-4240-b60a-634c70d20394/cispr-16-1-4-2010>

NOTE 1 A CALTS is used for determining the free-space antenna factor of an antenna.

NOTE 2 Site attenuation measurements of a CALTS are used for comparison to corresponding site attenuation measurements of a compliance test site, in order to evaluate the performance of the compliance test site.

3.1.4

common mode absorption device

CMAD

device that may be applied on cables leaving the test volume in radiated emission measurements to reduce the compliance uncertainty

3.1.5

compliance test site

COMTS

environment that assures valid, repeatable measurement results of the disturbance field strength from equipment under test for comparison to a compliance limit

3.1.6

cross-polar response

measure of the rejection by the antenna of the cross-polarized field, when the antenna is rotated in a linearly polarized electromagnetic field that is uniform in phase and amplitude over the aperture of the antenna under test

3.1.7

fully-anechoic room

FAR

shielded enclosure, the internal surfaces of which are lined with radio-frequency-energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest

3.1.8**free-space-resonant dipole**

wire antenna consisting of two straight colinear conductors of equal length, placed end to end, separated by a small gap, with each conductor approximately a quarter-wavelength long such that at the specified frequency, the input impedance of the wire antenna measured across the gap is pure real when the dipole is located in the free space

NOTE 1 In the context of this standard, this wire antenna connected to the balun is also called the "test antenna".

NOTE 2 This wire antenna is also referred to as "tuned dipole".

3.1.9**hybrid antenna**

conventional wire-element log-periodic dipole array (LPDA) antenna with boom lengthened at the open-circuit end to add one broadband dipole (e.g. biconical or bow-tie), such that the infinite balun (boom) of the LPDA serves as a voltage source for the broadband dipole

Typically a common-mode choke is used at this end of the boom to minimize parasitic (unintended) RF currents on the outer conductor of the coaxial cable flowing into the receiver.

3.1.10**insertion loss**

loss arising from the insertion of a device into a transmission line, expressed as the ratio of voltages immediately before and after the point of insertion of a device under test, before and after the insertion

It is equal to the inverse of the transmission S -parameter, $|1/S_{21}|$

3.1.11**low-uncertainty antenna**

robust biconical or LPDA antenna that meets the balance and cross-polar performance requirements of this standard, and whose antenna factor has an uncertainty of less than $\pm 0,5$ dB, used for the measurement of E -field strength at a defined point in space

NOTE It is further described in A.2.3.

3.1.12**quasi-free-space test site**

facility for radiated emission measurements, or antenna calibration, that is intended to achieve free-space conditions

Unwanted reflections from the surroundings are kept to a minimum in order to satisfy the site acceptance criterion applicable to the radiated emission measurement or antenna calibration procedure being considered.

3.1.13**reflection coefficient**

ratio of a common quantity to both the reflected and incident travelling waves

Hence, the voltage reflection coefficient is defined as the ratio of the complex voltage of the reflected wave to the complex voltage of the incident wave. The voltage reflection coefficient is equal to the scattering parameter S_{11} .

3.1.14**scattering parameters (S -parameters)**

set of four parameters used to describe the properties of a two-port network inserted into a transmission line

3.1.15**semi-anechoic chamber****SAC**

~~shielded enclosure, in which five of the six internal surfaces are lined with radio-frequency energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest, and the bottom horizontal surface is a conducting ground plane for use with OATS test set-ups~~

shielded enclosure in which all surfaces except the metal floor are covered with material that absorbs electromagnetic energy (i.e. RF absorber) in the frequency range of interest

3.1.16**short-open-load-through calibration method****SOLT**

through-open-short-match calibration method

TOSM

calibration method for a vector network analyzer using three known impedance standards – short, open, and match/load, and a single transmission standard – through

The SOLT method is widely used, and the necessary calibration kits with 50 Ω characteristic impedance components are commonly available. A full two-port error model includes six error terms for each of the forward and reverse directions, for a total of twelve separate error terms, and requires twelve reference measurements to perform the calibration.

3.1.17**site attenuation**

minimum site insertion loss measured between two polarization-matched antennas located on a test site when one antenna is moved vertically over a specified height range and the other is set at a fixed height

3.1.18**site insertion loss**

loss between a pair of antennas placed at specified positions on a test site, when a direct electrical connection between the generator output and receiver input is replaced by transmitting and receiving antennas placed at the specified positions

3.1.19**test volume**

volume in ~~the a~~ FAR in which the EUT is positioned

NOTE In this volume, the quasi-free-space condition is met and this volume is typically 0,5 m or more from the absorbing material of ~~the a~~ FAR.

3.1.20**through-reflect-line (TRL) calibration**

calibration method for a vector network analyzer using three known impedance standards “through”, “reflect” and “line” for the internal or external calibration of the VNA

Four reference measurements are needed for this calibration.

3.1.21**vector network analyzer****VNA**

network analyzer capable of measuring complex values of the four S -parameters S_{11} , S_{12} , S_{21} , S_{22}