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INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

AMENDMENT 1

AMENDEMENT 1

Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-5: Radio disturbance and immunity measuring apparatus – Specifications and validation procedures for CALTS and REFTS from 30 MHz to 1 000 MHz

Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-5: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Spécifications et procédures de validation relatives aux CALTS et aux REFTS dans la plage comprise entre 30 MHz et 1 000 MHz

CISPR 16-1-5:2003/A1:2012

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FOREWORD

This amendment has been prepared by subcommittee A: Radio-interference measurements and statistical methods, of IEC technical committee CISPR: International special committee on radio interference.

The text of this amendment is based on the following documents:

FDIS	Report on voting
CISPR/A/994A/FDIS	CISPR/A/1004/RVD

Full information on the voting for the approval of this amendment 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- withdrawn,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.

Replace the existing title of this standard by the following new title:

Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-5: Radio disturbance and immunity measuring apparatus – Specifications and validation procedures for CALTS and REFTS from 30 MHz to 1 000 MHz

1 Scope

Replace the first paragraph of this clause by the following new paragraph:

This part of CISPR 16 specifies the requirements for calibration test sites used to perform antenna calibrations and for reference test sites used to measure the antenna-pair reference site attenuation for compliance test site validations. It describes the test antenna characteristics, calibration and reference test site verification procedures and site compliance criteria. Further information on calibration site requirements, test antenna considerations and the theory of antennas and site attenuation is provided in informative annexes.

2 Normative references

*Replace, in the existing list of references, the reference to "*CISPR 16-1-4:2003*" by the following new reference:*

CISPR 16-1-4:2010, *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*

3.1
calibration test site (CALTS)

Replace the existing definition by the following new definition and new note:

open-area test site with metallic ground plane and tightly specified site attenuation performance in horizontal electric field polarization

NOTE A CALTS is used for the measurement of height dependent AF, and by the standard site method to measure free-space AF. A CALTS can also be validated for vertical polarization via 4.7. See the related definition of a REFTS.

3.6
site attenuation

Replace the existing term and definition by the following new term and definition:

site attenuation
SA
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

Add, after the existing term 3.8, the following new terms and definitions 3.9 and 3.10:

3.9
site insertion loss
transmission loss between a pair of antennas placed at specified positions on a test site, when a direct electrical connection between the signal generator output and the measuring receiver input is replaced by transmitting and receiving antennas placed at the specified positions

3.10
reference test site
REFTS
open-area test site with metallic ground plane and tightly specified site attenuation performance in horizontal and vertical electric field polarizations

NOTE Site attenuation measurements of a REFTS are used for comparison to corresponding site attenuation measurements of a COMTS to evaluate the performance of the COMTS.

4 Specifications and validation procedures for a test site to be used to calibrate antennas in the frequency range of 30 MHz to 1 000 MHz

Replace the existing title of this clause by the following new title:

4 Specifications and validation procedures for CALTS and REFTS from 30 MHz to 1 000 MHz

Replace, in the last sentence of this subclause, "5.6 of CISPR 16-1-4" *by "*5.2.6 of CISPR 16-1-4*".*

4.1 Introduction

Replace the existing title of this subclause by the following new title

4.1 General

Replace the existing second paragraph of this subclause by the following new paragraph:

In order for a CALTS to be used as a reference test site for validating the performance of test sites according to Clause 5 of CISPR 16-1-4, the CALTS should be verified using both horizontal and vertical antenna polarizations, as described in 4.7, whereupon it qualifies for use as a REFTS. Test sites specified in Clause 5 of CISPR 16-1-4 that are used for demonstrating compliance with radiated emission limits are referred to herein as compliance test sites (COMTS). Validation of a COMTS may be obtained by comparing it to the theoretical site attenuation given in Clause 5 of CISPR 16-1-4, or by comparing the site attenuation measured on a REFTS to the corresponding site attenuation measured on the COMTS, using the same antennas and the same antenna set-up geometry.

4.2.2 Normative specification

Replace the existing text of this subclause, including Notes 1 and 2, by the following new text:

For the calibration of antennas, the CALTS shall comply with the validation criteria given in 4.5.3.1 at all frequencies at which the antennas shall be calibrated. The tests in 4.4.3.2 and their associated criteria in 4.5.3.2 and 4.5.3.3 are optional, but are included for those who want to confirm the achievement in 4.5.3.1 of $T_{SA}(f)$ to less than 0,7 dB.

4.6.2 Validation report requirements

Replace, in the existing first sentence of item b), "(see 4.2.2a)*" by "*(see 4.2.2)*".*

4.7 Validation of the CALTS for vertical polarization

Replace the existing title of this subclause by the following new title:

4.7 Validation of a REFTS

*Delete the existing text of this subclause "*Under consideration.*"*

4.7.1 Introduction

Replace the existing title of this subclause by the following new title:

4.7.1 General

Add the following new text to this subclause:

A REFTS shall meet all requirements of Annex A and be validated with site attenuation measurements for both horizontal and vertical polarizations. The test antenna for SA measurements is specified in 4.3. In horizontal polarization SA measurements shall meet the requirements of 4.4 except 4.4.3.2, 4.4.5 and 4.4.6. The criteria are specified in 4.7.3. Criteria required for a CALTS described in 4.5.3.2 and 4.5.3.3 are not required for a REFTS. The test antenna for SA measurements is specified in 4.3. In horizontal polarization SA measurements shall meet the relevant requirements of 4.4 to 4.6. In vertical polarization SA measurements shall meet the requirements of 4.7.3.

4.7.2 Site specification

Replace the existing title of this subclause by the following new title:

4.7.2 Site insertion loss measurements for vertical polarization

Add the following new text and subclauses to this subclause:

4.7.2.1 General

The following precautions are applicable to vertically polarized antennas in addition to the requirements for horizontally polarized antennas.

4.7.2.2 Antenna mounting and antenna mast requirements

The antenna separation shall be 10 m. The height of the centre of the transmitting antenna shall be 2 m, except at 30 MHz, 35 MHz and 40 MHz, where the height shall be 2,75 m. The frequency and the receive antenna heights shall be chosen according to Table 3.

The bottom tip of the antenna shall be at least 0,25 m above the ground plane. The antenna mast should be made of low-density dielectric material, and demonstrated to have minimal effects on the antenna response. Effects of the mast and horizontal boom on the antenna factor shall be evaluated by measuring the transmission loss between two antennas with the mast position varied relative to the antenna, varying the distance between the antenna and the vertical part of the mast.

NOTE The procedure for evaluating mast effects is described in more detail in 5.4.2.3.3 of CISPR 16-1-4:2010.

Effort shall be made to minimize the influence of the antenna mast, e.g. by increasing the distance between the antenna and the vertical part of the mast by mounting the antenna on a horizontal boom.

Table 3 – Antenna heights

f MHz	h_t m	h_r m	f MHz	h_t m	h_r m	f MHz	h_t m	h_r m
30	2,75	2,75	90	2,0	1,15	300	2,0	2,6
35	2,75	2,4	100	2,0	1,0	400	2,0	1,8
40	2,75	2,4	120	2,0	1,0	500	2,0	1,4
45	2,0	1,9	140	2,0	1,0	600	2,0	1,4
50	2,0	1,9	160	2,0	1,0	700	2,0	1,0
60	2,0	1,5	180	2,0	1,0	800	2,0	1,0
70	2,0	1,5	200	2,0	1,0	900	2,0	1,6
80	2,0	1,15	250	2,0	3,1	1 000	2,0	1,6

h_t and h_r are transmit and receive antenna heights, respectively.

4.7.2.3 Cable layout

Cables can act as parasitic reflectors when aligned with the antenna elements, which can change the site insertion loss in the order of ± 1 dB if a cable drops as close as 0,5 m to the rear element of the antenna. Effects of the cables can be evaluated by varying this horizontal distance until the effects on SA are negligible. At the distance finally chosen for the measurement, any influence caused by the cables will then be masked by uncertainties of the REFTS. Clamp-on ferrites placed on the cable can reduce this effect, especially where the antenna has a poor balun. It is recommended that cables extend horizontally behind the antenna (orthogonal to the antenna elements) for a minimum of 5 m for a CALTS and 2 m for a REFTS before dropping to the ground.

4.7.2.4 Ground plane size

Depending on the ratio of the separation distance between the antennas and the distance to the edges of an OATS ground plane, a non-negligible edge diffraction effect may occur. The presence of diffraction effects can be observed as a regular ripple superimposed on the data from a swept frequency SA measurement. The ripple is pronounced in regions of minima of the SA data. In some cases ripple can be reduced by placing the antennas such that the

measurement path is on the short axis, rather than the long axis, of the test site. Edge diffraction may also be reduced by enlarging the ground plane using additional wire mesh connected to the perimeter of the ground plane, and into the earth/ground, but the earth/soil shall be kept very damp for this to be effective. Another solution is to increase the size of the ground plane.

4.7.3 Validation procedure

Replace the existing title of this subclause by the following new title:

4.7.3 Compliance criterion

Add the following new text to this subclause:

The compliance criterion is given by Equation (6) over the frequency range of 30 MHz to 1 000 MHz with $T_{SA}(f)$ = 1,0 dB for a CALTS and $T_{SA}(f)$ = 1,5 dB for a REFTS. The measurement uncertainty ΔSA_m shall be evaluated for this equation according to 4.5.2.

4.7.4 Compliance criteria

Replace the existing title of this subclause by the following new title:

4.7.4 Validation report

Add the following new text to this subclause:

The requirements for the site validation report are the same as in 4.6.2.

4.7.5 Validation report

Delete this subclause.

B.2.2 Relations between balun properties and *S*-parameters

Replace the existing Equation (B.2) by the following new equation:

$$\begin{pmatrix} Z_{22} & Z_{23} \\ Z_{32} & Z_{33} \end{pmatrix} = \frac{Z_0}{(1-S_{22})(1-S_{33})-S_{23}S_{32}} \times \begin{pmatrix} [(1+S_{22})(1-S_{33})+S_{23}S_{32}] & 2S_{23} \\ 2S_{32} & [(1-S_{22})(1+S_{33})+S_{23}S_{32}] \end{pmatrix} \quad \text{(B.2)}$$

Replace the existing sentence below Equation (B.2) by the following new sentence:

where Z_0 is the measurement impedance, typically 50 Ω.

Replace the existing Equation (B.3) by the following new equation:

$$Z_{AB} = \frac{1-S_{22}S_{33}+S_{23}S_{32}-S_{33}+S_{22}}{(1-S_{22})(1-S_{33})-S_{23}S_{32}} 100 = R_{AB} + jX_{AB} \quad (\Omega) \quad \text{(B.3)}$$

C.1 Analytical relations

Add, after the last paragraph of this clause, the following new paragraph:

Alternatively the SA_c values can be calculated by numerical modelling as described in C.2. Numerical modelling is more versatile and gives more accurate results outside the resonant frequency than the analytical equations presented here. The agreement of the two methods at resonance is better than 0,03 dB.

C.1.3.2 ΔSA_t calculations (table C.2)

Replace, in the second paragraph after Table C.1, "numerical techniques" *by* "numerical modelling".

C.2 Numerical calculations

Replace the existing title of this clause by the following new title:

C.2 Numerical modelling

Add, after the existing Subclause C.2.3, the following new Subclause C.2.4 and new Table C.5:

C.2.4 Example site attenuation values

Examples of site attenuation values are given in Table C.5. The same antenna lengths and radii, L_a and R_{we}, as in Table C.1, are used. If different dipole radii are used, the operator shall calculate the free-space resonant lengths and new SA_c values. The antenna separation is 10 m, and the height of the centre of the transmitting antenna is 2 m, except at 30 MHz, 35 MHz and 40 MHz, where a height of 2,75 m has been chosen. The receive antenna heights are chosen to reduce the number of height changes, but are near to the height giving the maximum signal. The SA_c values in Tables C.2 and C.5 can be calculated using C.1.

NOTE The quantity symbol for calculated site attenuation is shown in this amendment as "SA_c", consistent with the base standard. In the next edition of CISPR 16-1-5, the quantity symbol will change to "A_{sc}", consistent with current CISPR practice for presenting quantity symbols.

Table C.5 – Numerical example calculation of SA_c for vertical polarization, h_t = 2 m, except h_t = 2,75 m at 30 MHz, 35 MHz and 40 MHz

f MHz	h_r m	SA_c dB	f MHz	h_r m	SA_c dB	f MHz	h_r m	SA_c dB
30	2,75	16,48	90	1,15	23,30	300	2,6	33,38
35	2,4	16,97	100	1,0	24,33	400	1,8	35,68
40	2,4	17,83	120	1,0	25,81	500	1,4	37,61
45	1,9	18,66	140	1,0	27,27	600	1,4	39,14
50	1,9	18,90	160	1,0	28,97	700	1,0	40,37
60	1,5	20,14	180	1,0	30,76	800	1,0	41,24
70	1,5	21,05	200	1,0	32,46	900	1,6	43,21
80	1,15	22,28	250	3,1	32,20	1 000	1,6	43,48
h_r is the receive antenna height.								

AVANT-PROPOS

Le présent amendement a été établi par le sous-comité A: Mesures des perturbations radioélectriques et méthodes statistiques, du comité d'études CISPR de la CEI: Comité international spécial des perturbations radioélectriques.

Le texte de cet amendement est issu des documents suivants:

FDIS	Rapport de vote
CISPR/A/994A/FDIS	CISPR/A/1004/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cet amendement.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de la CEI sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

Remplacer le titre existant de la présente norme par le nouveau titre suivant:

Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-5: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Spécifications et procédures de validation relatives aux CALTS et aux REFTS dans la plage comprise entre 30 MHz et 1 000 MHz

1 Domaine d'application

Remplacer le premier alinéa de cet article par le nouvel alinéa suivant:

La présente partie de la CISPR 16 spécifie les exigences relatives aux emplacements d'essai pour l'étalonnage utilisés pour réaliser les étalonnages des antennes et relatives aux emplacements d'essai de référence utilisés pour mesurer l'affaiblissement d'emplacement de référence des paires d'antennes pour les validations des emplacements d'essais de conformité. Elle décrit les caractéristiques des antennes d'essai, les procédures de vérification des emplacements d'essai d'étalonnage et des emplacements d'essai de référence, ainsi que les critères de conformité des emplacements d'essai. Des informations complémentaires sur les exigences pour des emplacements pour l'étalonnage, des considérations sur l'antenne d'essai et la théorie des antennes et de l'affaiblissement de l'emplacement sont données en annexes informatives