BRITISH STANDARD

BS EN
55022 : 1995
CISPR 22 : 1993

Limits and methods of measurement of radio disturbance characteristics of information technology equipment

The European Standard EN 55022 : 1994 has the status of a British Standard

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee GEL/110, Electromagnetic compatibility, to Subcommittee GEL/110/7, Interference characteristics of information technology equipment, upon which the following bodies were represented:

Association of Consulting Scientists
British Radio and Electronic Equipment Manufacturers' Association
Federation of the Electronics Industry
GAMBICA (BEAMA Ltd.)
British Telecommunications plc
ERA Technology Ltd.
Mercury Communications Ltd.
National Air Traffic Services
OFTEL (Office of Telecommunications)
Power Supply Manufacturers' Association - PSMA (BEAMA Ltd.)
Radio Communications Agency

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on
15 April 1995

The following BSI references relate to the work on this standard:
Committee reference GEL/110/7
Draft for comment 92/[illegible] DC

Amendments issued since publication

Amd. No.	Date	Text affected

Contents

National foreword

This British Standard has been prepared under the direction of the Electrotechnical Sector Board and is the English language version of EN 55022 : 1994, *Limits and methods of measurement of radio disturbance characteristics of information technology equipment*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with CISPR 22 : 1993 published by the International Electrotechnical Commission (IEC).

Reference is made in the foreword of EN 55022 : 1994 to the fact that for products which conform to EN 55022 : 1987 before 31 December 1995, as shown by the manufacturer or by a certification body, the previous standard may continue to apply for production until 31 December 1998. For this reason BS 6527 : 1988, which is superseded by this British Standard, will be withdrawn but may still be referred to in these circumstances.

Cross-reference

International standard	Corresponding British Standard
EN 55011 (CISPR 11 (modified))	BS EN 55011 : 1991 *Specification for limits and methods of measurement of radio disturbance characteristics of industrial scientific amd medical (ISM) radio-frequency equipment*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 55022

August 1994

UDC 681.3:621.391.82

Supersedes EN 55022 : 1987 incorporates corrigendum February 1995

Descriptors: Radio interference, information technology equipment, methods of measurement, characteristics

English version

Limits and methods of measurement of radio disturbance characteristics of information technology equipment

(CISPR 22 : 1993)

Limites et méthodes de mesure des caractéristiques de perturbations radioélectriques produites par les appareils de traitement de l'information
(CISPR 22 : 1993)

Grenzwerte und Meβverfahren für Funkstörungen von Einrichtungen der Informationstechnik
(CISPR 22 : 1993)

This European Standard was approved by CENELEC on 1992-12-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, 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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Ref. No. EN 55022 : 1994 E

Foreword

At the request of the CENELEC Sub-committee SC 110A, EMC Products, a number of Draft International Standards containing proposed amendments to CISPR Publication 22 were submitted to the CENELEC Unique Acceptance Procedure (UAP) for acceptance as amendments to the European Standard EN 55022 : 1987.

The CISPR Publication and the relevant DIS were combined by IEC into a new edition of CISPR 22, the text of which was approved by CENELEC as EN 55022 on 1992-12-09.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1994-12-15
- latest date of withdrawal of conflicting national standards (dow) 1995-12-31

For products which have complied with EN 55022 : 1987 before 1995-12-31, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1998-12-31.

Annexes designated 'normative' are part of the body of the standard. In this standard, annexes A and ZA are normative.

CONTENTS

INTRODUCTION

The scope is extended to the whole radio frequency range from 9 kHz to 400 GHz, but limits are formulated only in restricted frequency bands which is considered sufficient to reach adequate emission levels to protect radio broadcast and telecommunication services and to allow other apparatus to operate as intended at reasonable distance.

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF INFORMATION TECHNOLOGY EQUIPMENT

1 Scope and object

This standard applies to ITE as defined in 3.1.

Procedures are given for the measurement of the levels of spurious signals generated by the ITE and limits are specified for the frequency range 9 kHz to 400 GHz for both Class A and Class B equipment. No measurements need be performed at frequencies where no limits are specified.

The intention of this standard is to establish uniform requirements for the radio disturbance level of the equipment contained in the scope, to fix limits of disturbance, to describe methods of measurement and to standardize operating conditions and interpretation of results.

2 Normative references

The following standards are referred to in this publication:

IEC 83: 1975, *Plugs and socket-outlets for domestic and similar general use – Standards*

IEC 625, *An interface system for programmable measuring instruments (byte serial, bit parallel)*

CISPR 11: 1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment*

CISPR 16: 1987, *CISPR specification for radio interference measuring apparatus and measurement methods*

CISPR 16-1: 1993, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 16-2: 19XX, *CISPR specification for radio disturbance and immunity measuring apparatus and methods – Part 2: Methods of disturbance and immunity measurements* (under consideration)

NOTE – CISPR 16 (1987) should be used until CISPR 16-2 is available.

CCITT V.24: 1993, *List of definitions for interchange circuits, between data terminal equipment (DTE) and data circuit terminating equipment (DCE)*

3 Definitions

For the purpose of this standard the following definitions apply:

3.1 *Information Technology Equipment (ITE)*

Any equipment:

a) which has a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer;

b) with a rated supply voltage not exceeding 600 V.

It includes, for example, data processing equipment, office machines, electronic business equipment, and telecommunication equipment.

Any equipment (or part of the ITE equipment) which has a primary function of radio transmission and/or reception according to the ITU Radio Regulations are excluded from the scope of this standard.

NOTE – Any equipment which has a function of radio transmission and/or reception according to the definitions of the ITU Radio Regulations should fulfil the national radio regulations, whether or not CISPR 22 is also valid.

Equipment, for which all disturbance requirements in the frequency range are explicitly formulated in other IEC or CISPR publications, are excluded from the scope of this standard.

3.2 **equipment under test (EUT)**: A representative ITE or functionally interactive group of ITE (i.e. system) which includes one or more host unit(s) and which is being evaluated.

3.3 **host unit**: Part of an ITE system or unit that provides the mechanical housing for modules, which may contain radio-frequency sources, and may provide power distribution to other ITE. Power distribution may be a.c., d.c., or both between the host unit(s) and modules or other ITE.

3.4 **module**: Part of an ITE which provides a function and may contain radio-frequency sources.

3.5 **identical modules and ITE**: Modules and ITE produced in quantity and within normal manufacturing tolerances to a given manufacturing specification.

4 Classification of ITE

ITE is subdivided into two categories denoted Class A ITE and Class B ITE.

4.1 *Class B ITE*

Class B ITE is a category of apparatus which satisfies the Class B ITE disturbance limits.

Class B ITE is intended primarily for use in the domestic environment and may include:

- equipment with no fixed place of use; for example, portable equipment powered by built-in batteries;
- telecommunication terminal equipment powered by a telecommunication network;
- personal computers and auxiliary connected equipment.

NOTE – The domestic environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10 m of the apparatus concerned.

4.2 *Class A ITE*

Class A ITE is a category of all other ITE which satisfies the Class A ITE limits but not the Class B ITE limits. Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use:

Warning

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

5 Limits for conducted disturbance

5.1 *Limits for conducted disturbance at mains ports*

The equipment under test (EUT) shall meet the limits of disturbance of tables 1 or 2 including the average limits and the quasi-peak limits when using, respectively, an average detector receiver and a quasi-peak detector receiver, and measured in accordance with the methods described in clause 10. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the highest reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

Table 1 – Limits for conducted disturbance at the mains ports of Class A ITE

Frequency range MHz	Limits dB (μV)	
	Quasi-peak	Average
0,15 to 0,50	79	66
0,5 to 30	73	60
NOTE – The lower limit shall apply at the transition frequency.		

Table 2 – Limits for conducted disturbance at the mains ports of Class B ITE

Frequency range MHz	Limits dB (μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

NOTES
1 The lower limit shall apply at the transition frequencies.
2 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.

5.2 *Limits for conducted disturbance at telecommunication ports*

Under consideration.

6 Limits for radiated disturbance

The EUT shall meet the limits of tables 3 or 4 when measured at the measuring distance *R* in accordance with the methods described in clause 11. If the reading on the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the highest reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

Table 3 – Limits for radiated disturbance of Class A ITE at a measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB (μV/m)
30 to 230	40
230 to 1 000	47

NOTES
1 The lower limit shall apply at the transition frequency.
2 Additional provisions may be required for cases where interference occurs.

TABLE 4 - Limits for radiated disturbance of Class B ITE at a measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB (μV/m)
30 to 230	30
230 to 1 000	37

NOTES
1 The lower limit shall apply at the transition frequency.
2 Additional provisions may be required for cases where interference occurs.

7 Limits for disturbance power

The authorities in certain countries apply, in the case of Class B equipment, the measurement of and limits for disturbance power for regulatory and control purposes. In this standard, the limits for, and measurement of, disturbance power of ITE are under consideration.

NOTE – Those countries which already have provision for using the absorbing clamp in their national standards may continue to include those provisions while the subject remains under consideration.

8 Interpretation of CISPR radio disturbance limit

8.1 *Significance of a CISPR limit*

8.1.1 A CISPR limit is a limit which is recommended to national authorities for incorporation in national standards, relevant legal regulations and official specifications. It is also recommended that international organizations use these limits.

8.1.2 The significance of the limits for equipment shall be that on a statistical basis at least 80 % of the mass-produced equipment complies with the limits with at least 80 % confidence.

8.2 *Application of limits in tests for conformity of equipment in series production*

8.2.1 Tests shall be made:

8.2.1.1 Either on a sample of equipment of the type using the statistical method of evaluation set out in 8.2.3.

8.2.1.2 Or, for simplicity's sake, on one equipment only.

8.2.2 Subsequent tests are necessary from time to time on equipment taken at random from production, especially in the case referred to in 8.2.1.2.

8.2.3 Statistically assessed compliance with limits shall be made as follows:

This test shall be performed on a sample of not less than five and not more than 12 items of the type but if, in exceptional circumstances, five items are not available, a sample of four or three shall be used. Compliance is judged from the following relationship:

$$\bar{x} + kS_n \leq L$$

where

$\bar{x}$ is the arithmetic mean of the measured value of n items in the sample

$$S_n^2 = \frac{1}{n-1} \sum (x_n - \bar{x})^2$$

x_n is the value of the individual item

L is the appropriate limit

k is the factor derived from tables of the non-central t-distribution which assures with 80 % confidence that 80 % of the type is below the limit; the value of k depends on the sample size n and is stated below.

The quantities x_n, $\bar{x}$, S_n and L are expressed logarithmically: dB(μV), dB(μV/m) or dB(pW).

n	3	4	5	6	7	8	9	10	11	12
k	2,04	1,69	1,52	1,42	1,35	1,30	1,27	1,24	1,21	1,20

NOTE – For general information, see CISPR 16, Section Nine.

8.2.4 The banning of sales, or the withdrawal of a type approval, as a result of a dispute shall be considered only after tests have been carried out using the statistical method of evaluation in accordance with 8.2.1.1.

9 General measurement conditions

A test site shall permit disturbances from the EUT to be distinguished from ambient noise. The suitability of the site in this respect can be determined by measuring the ambient noise levels with the EUT inoperative and ensuring that the noise level is at least 6 dB below the limits specified in clauses 5 and 6.

If at certain frequency bands the ambient noise is not 6 dB below the specified limit, the methods shown in 11.4 may be used to show compliance of the EUT to the specified limits.

It is not necessary that the ambient noise level be 6 dB below the specified limit where both ambient noise and source disturbance combined do not exceed the specified limit. In this case the source emanation is considered to satisfy the specified limit. Where the combined ambient noise and source disturbance exceed the specified limit, the EUT shall not be judged to fail the specified limit unless it is demonstrated that, at any measurement frequency for which the limit is exceeded, two conditions are met:

a) the ambient noise level is at least 6 dB below the source disturbance plus ambient noise level;

b) the ambient noise level is at least 4,8 dB below the specified limit.

9.1 *EUT configuration*

An attempt shall be made to maximize the disturbance consistent with the typical applications by varying the configuration of the test sample. Interface cables shall be connected to the available interface ports of the EUT. This includes, but is not limited to, standard interface bus ports (e.g. IEC 625 and CCITT V.24*) provided on computers and peripherals. The effect of varying the position of the cables shall be investigated to find the configuration that produces maximum disturbance. The configuration shall be precisely noted in the test report.

Interconnecting cables should be of the type and length specified in the individual equipment requirements. If the length can be varied, the length shall be selected to produce maximum disturbance.

If shielded or special cables are used during the tests to achieve compliance, then a note shall be included in the instruction manual advising of the need to use such cables.

Excess lengths of cables shall be bundled at the approximate centre of the cable with the bundles 30 cm to 40 cm in length. If it is impractical to do so because of cable bulk or stiffness, or because the testing is being done at a user installation, the disposition of the excess cable shall be precisely noted in the test report.

Where there are multiple interface ports all of the same type, connecting a cable to just one of that type of port is sufficient provided it can be shown that the additional cables would not significantly affect the results.

Any set of results shall be accompanied by a complete description of the cable and equipment orientation so that results can be repeated. If specific conditions of use are required to meet the limits, those conditions shall be specified and documented; for example cable length, cable type, shielding and grounding. These conditions shall be included in the instructions to the user.

One module of each type shall be operative in each ITE evaluated in an EUT. For a system EUT, one of each type of ITE that can be included in the possible system configuration shall be included in the EUT.

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* These publications correspond to IEEE 488 and RS-232-C respectively.

The results of an evaluation of EUT's having one of each type of module or ITE can be applied to configurations having more than one of each of those modules or ITE. This is permissible because it has been found that disturbances from identical modules or ITE (see 3.5) are in practice generally not additive.

In the case of EUT's which functionally interact with other ITE, including any ITE that is dependent on a host unit for its power interface, either the actual interfacing ITE or simulators may be used to provide representative operating conditions provided the effects of the simulator can be isolated or identified. If an ITE is designed to be a host unit to other ITE, such ITE may have to be connected in order that the host unit shall operate under normal conditions.

It is important that any simulator used instead of an actual interfacing ITE properly represents the electrical and, in some cases, the mechanical characteristics of the interfacing ITE, especially RF signals and impedances. Following this procedure will permit the results of measurements of individual ITE to remain valid for system application and integration of the ITE with other similarly tested ITE, including ITE produced and tested by different manufacturers.

9.1.1 *Ground-plane*

The EUT situation relative to the ground-plane shall be equivalent to that occurring in use, that is floor-standing equipment is placed on a ground-plane or on an isolating floor (for example, wood) close to a ground-plane, and portable equipment is placed on a non-metallic table. The power and signal cables shall be oriented with respect to the ground-plane in a manner equivalent to actual use. The ground-plane may be of metal.

NOTE – Specific ground-plane requirements are given in 10.3 for conducted disturbance measurements and in 11.3.4 for radiated disturbance measurements.

10 Method of measurement of conducted disturbance at mains ports

Measurements shall be carried out using quasi-peak and average detector receivers described in 10.1. Both detectors may be incorporated in a single receiver and measurements carried out by alternatively using the quasi-peak detector and the average detector.

10.1 *Measuring receivers*

Receivers with quasi-peak detectors shall be in accordance with section one of CISPR 16. Receivers with average detectors shall be in accordance with clause 23, Section Five, of CISPR 16.

10.2 *Artificial Mains Network (AMN)*

An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines.

A network with a nominal impedance (50 Ω/50 μH) as defined in 8.2.2, Section Two, of CISPR 16 shall be utilized.

Connection of the EUT to the AMN is required. The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0,8 m.

Where a mains flexible cord is provided by the manufacturer this shall be 1 m long or if in excess of 1 m the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0,4 m in length.

Where a mains cable is specified in the manufacturer's installation instructions, a 1 m length of the type specified shall be connected between the EUT and the AMN.

The EUT shall be arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values shall be within the appropriate limits.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the network and, where not otherwise provided or specified by the manufacturer, shall be 1 m long and run parallel to the mains connection at a distance of not more than 0,1 m.

Other ground connections (for example for EMC purposes), either specified or supplied by the manufacturer for connection to the same ultimate terminal as the safety ground connection, shall also be connected to the reference ground of the network.

It may not be possible to measure at some frequencies because of conducted ambient noise which couples from local broadcast service fields. A suitable additional radio-frequency filter may be inserted between the AMN and the mains supply, or measurements may be performed in a shielded enclosure. The components forming the additional radio-frequency filter should be enclosed in a metallic screen directly connected to the reference ground of the measuring system. The requirements for the impedance of the AMN should be satisfied at the frequency of the measurement, with the additional radio-frequency filter connected.

Where the EUT is a collection of ITE with one or more host units and ITE each having its own power cord, the point of connection for the AMN is determined from the following rules:

a) Each power cord which is terminated in a power supply plug of a standard design (IEC 83 for example) shall be tested separately.

b) Power cords or terminals which are not specified by the manufacturer to be connected via a host unit shall be tested separately.

c) Power cords or field wiring terminals which are specified by the manufacturer to be connected via a host unit or other power-supplying equipment shall be connected to that host unit or other power-supplying equipment, and the terminals or cords of that host unit or other power-supplying equipment are those considered for connection to the AMN and tested.

d) Where a special connection is specified, the necessary hardware to effect the connection shall be supplied by the manufacturer for the purpose of this test.

10.3 *Ground-plane*

The EUT, where intended for table-top use, shall be placed 0,4 m from a vertical metal reference plane of at least 2 m by 2 m and shall be kept at least 0,8 m from any other metal surface or other ground-plane not being part of the EUT. If the measurement is made in a screened enclosure, the distance of 0,4 m may be referred to one of the walls of the enclosure.

Floor-standing EUT's shall be placed on a horizontal metal ground-plane, the point(s) of contact being consistent with normal use but not in metallic contact with the ground-plane. A metal floor may replace the reference ground-plane. The reference ground-plane shall extend at least 0,5 m beyond the boundaries of the EUT and have minimum dimensions of 2 m by 2 m.

The reference ground point of the AMN and the Impedance Stabilization Network (ISN) shall be connected to the reference ground-plane with a conductor as short as possible.

11 Method of measurement of radiated disturbance

Measurements shall be conducted with a quasi-peak detector instrument in the frequency range of 30 MHz to 1 000 MHz.

11.1 *Measuring receivers*

The measuring receivers shall be in accordance with the requirements of Section One of CISPR 16.

11.2 *Antenna*

The antenna shall be a balanced dipole. For frequencies of 80 MHz or above, the antenna shall be resonant in length, and for frequencies below 80 MHz it shall have a length equal to the 80 MHz resonant length. Further detailed information is given in clause 15 of CISPR 16-1.

NOTE – Other antennas may be used, provided the results can be correlated with the balanced dipole antenna with an acceptable degree of accuracy.

11.2.1 *Antenna-to-EUT distance*

Measurements of the radiated field shall be made with the antenna located at the horizontal distance from the boundary of the EUT as specified in clause 6. The boundary of the EUT is defined by an imaginary straight-line periphery describing a simple geometric configuration encompassing the EUT. All ITE inter-system cables and connecting ITE shall be included within this boundary (see also figure 2).

NOTE – If the field-strength measurement at 10 m cannot be made because of high ambient noise levels or for other reasons, measurement of Class B EUTs may be made at a closer distance, for example 3 m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance. Care should be taken in the measurement of large EUTs at 3 m at frequencies near 30 MHz due to near field effects.

11.2.2 *Antenna-to-ground distance*

The antenna shall be adjusted between 1 m and 4 m in height above the ground-plane for maximum meter reading at each test frequency.

11.2.3 *Antenna-to-EUT azimuth*

Antenna-to-EUT azimuth shall also be varied during the measurements to find the maximum field-strength readings. For measurement purposes it may be possible to rotate the EUT. When this is not practicable the EUT remains in a fixed position and measurements are made around the EUT.

11.2.4 *Antenna-to-EUT polarization*

Antenna-to-EUT polarization (horizontal and vertical) shall be varied during the measurements to find the maximum field-strength readings.

11.3 *Measurement site for radiated disturbance measurements*

11.3.1 *General*

Test sites shall be validated by making site attenuation measurements for both horizontal and vertical polarization fields in the frequency range of 30 MHz to 1 000 MHz.

The distance between the transmitting and receiving antennas shall be the same as the distance used for the radiated disturbance tests of the EUT.

11.3.2 *Site attenuation measurements*

A measurement site shall be considered acceptable if the horizontal and vertical site attenuation measurements are within ±4 dB of the theoretical site attenuation of an ideal site (see also CISPR 16).

11.3.3 *Open-area test site*

The test site shall characteristically be flat, free of overhead wires and nearby reflecting structures, sufficiently large to permit antenna placement at the specified distance and provide adequate separation between antenna, EUT and reflecting structures. Reflecting structures are defined as those whose construction material is primarily conductive. The test site shall be provided with a horizontal metal ground-plane described in 11.3.4. Two such test sites are depicted in figures 1 and 2.

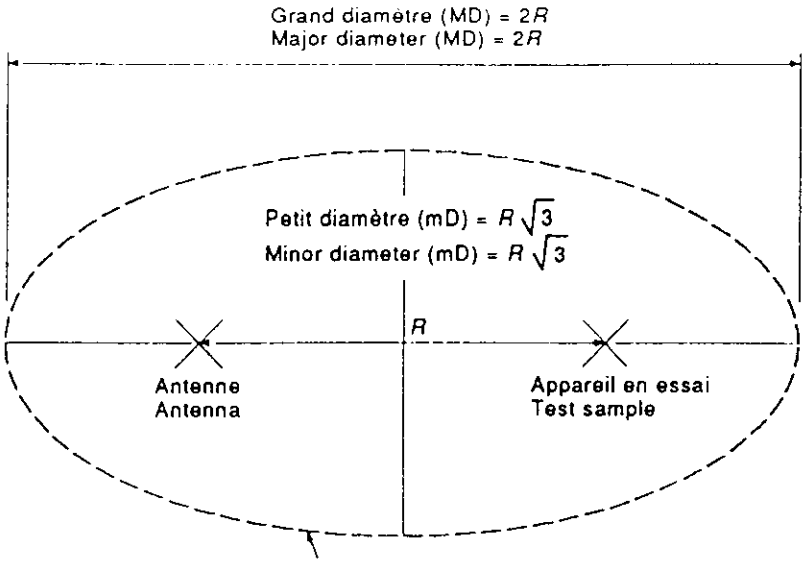
The test site shall satisfy the site attenuation requirements of CISPR 16-1 for open-area test sites.

11.3.4 *Conducting ground-plane*

A conducting ground-plane shall extend at least 1 m beyond the periphery of the EUT and the largest measuring antenna, and cover the entire area between the EUT and the antenna. It should be of metal with no holes or gaps having dimensions larger than one-tenth of a wavelength at the highest frequency of measurement. A larger size conducting ground-plane may be required if the site attenuation requirements of the test site are not satisfied.

11.3.5 *Alternative test sites*

Tests may be conducted on other test sites which do not have the physical characteristics described in 11.3.3 and 11.3.4. Evidence shall be obtained to show that such alternative sites will yield valid results. Such alternative sites are suitable for performing disturbance tests if the site attenuation measurements described in annex A meet the site attenuation requirements of 11.3.2.



L'espace au-dessus du sol doit être dégagé de tout objet réfléchissant.

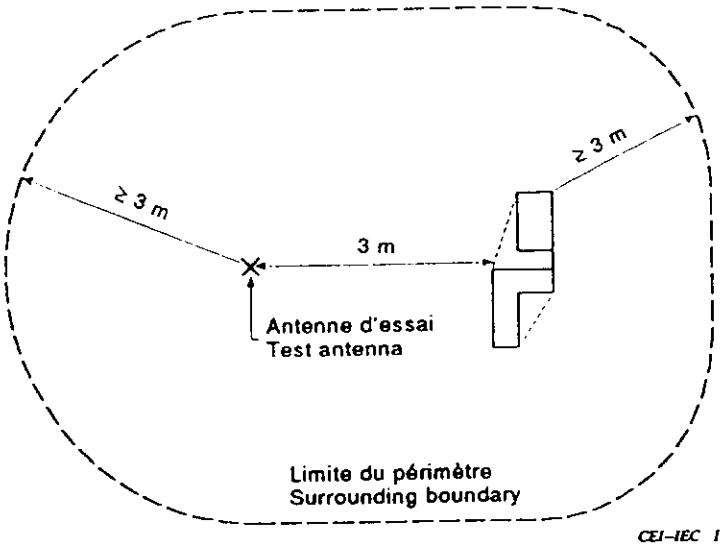
Volume above earth to be free of reflecting objects.

NOTE – Les caractéristiques de l'emplacement d'essai sont décrites en 11.3. Voir aussi l'article 6 pour la valeur de *R*.

Characteristics of test site described further in 11.3. See also clause 6 for the value of *R*.

Figure 1 – Emplacement d'essai

Test site



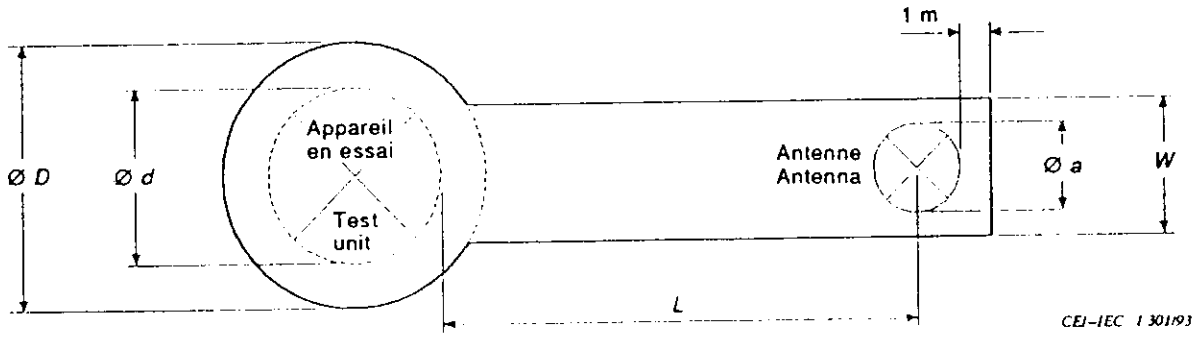
Aucun objet réfléchissant ne doit se trouver à l'intérieur du volume délimité au sol par le tracé correspondant à cette figure et en hauteur par un plan horizontal situé à ≥3 m au-dessus de l'élément le plus élevé: antenne ou équipement en essai.

There shall be no reflecting object inside the volume defined on the ground by the line corresponding to this figure and defined in height by a horizontal plane ≥3 m above the highest element of either aerial or equipment under test.

NOTE – Voir 11.3.3 pour l'utilisation d'un autre emplacement d'essai. La méthode des segments pour définir le périmètre de l'unité d'essai est décrite en 11.2.1.

See 11.3.3 for applicability of the alternate test site. Also, the peripheral string method is described in 11.2.1.

Figure 2 – Caractéristiques minimales d'un autre emplacement d'essai
Minimum alternative measurement site



$D = d + 2$ m, où d est la dimension maximale de l'appareil en essai
where d is the maximum test unit dimension

$W = a + 2$ m, où a est la dimension maximale de l'antenne
where a is the maximum antenna dimension

$L = 3$ m ou/or 10 m

Figure 3 – Dimensions minimales du plan de masse métallique
Minimum size of metal ground-plane

Annex A
(normative)

Site attenuation measurements of alternative test sites

A.1 Method of measurement of site attenuation

The transmit antenna shall be moved within a volume in both horizontal and vertical polarizations (see clause A.2, reference [2]) as shown in figure A.1. The recommended minimum volume includes lateral positions defined by a 1 m x 1,5 m test-table surface when rotated about its centre, and vertical extremities defined by typical EUT heights of both floor-standing and table-top equipment of 1,5 m or less as shown in figure A.2. Some test sites may require volumes larger than the recommended minimum depending upon the size of the typical equipment to be measured.

For these measurements, broadband antennas shall be used, and measurement distances shall be referenced between the centres of the antennas. The transmit and receive antennas shall be aligned with the antenna elements oriented orthogonal to the measurement axis so that the antenna elements are always parallel.

A.1.1 *Vertical polarization*

In the vertical polarization the height of the transmit antenna shall be 1 m to the centre of the antenna (a minimum clearance of 25 cm between the tip of the antenna and the ground-plane shall be maintained).

Measurements shall also be performed with the transmit height at 1,5 m under either of the following conditions:

a) the expected EUT height is greater than 1,5 m and less than 2 m.

b) the tip of the transmit antenna does not extend to within 90 % of the top of the expected EUT height when at the 1 m height.

The transmit antenna shall be located in the following four positions at the appropriate heights for the vertical polarization:

1) The exact centre of the turntable (see note 1).

2) A position 0,75 m forward of the turntable centre and toward the receiving antenna (lying on a line, i.e. the measurement axis, drawn between the turntable centre and the receive antenna).

3) A position 0,75 m behind the turntable centre and away from the receiving antenna unless this position is more than 1 m from the nearest vertical dielectric interface (see note 2).

4) The two positions 0,75 m on each side of centre (lying on a line drawn through the centre and normal to a line between the turntable centre and the receive antenna).

Normalized site attenuation (NSA) vertical polarization measurements shall be performed with the transmit and receive antenna separation held constant using table A.1. The receive antenna shall be moved to the nearest location maintaining the appropriate distance and along a line toward the turntable centre.

Assuming a maximum EUT height of 1,5 m, a minimum of four vertically polarized measurements are required (four positions in a horizontal plane at one height). See figure A.2(a)

A.1.2 *Horizontal polarization*

For NSA horizontal polarization measurements, two transmit heights shall be investigated. The lower height of the antenna shall be 1 m to the centre of the antenna, and the upper height shall be 2 m to the centre of the antenna (see table A.1). The following positions shall be measured at both antenna heights:

1) The exact centre of the turntable.

2) A position 0,75 m forward of the turntable centre and toward the receiving antenna.

3) A position 0,75 m behind the turntable centre and away from the receiving antenna unless this position is more than 1 m from the nearest vertical dielectric interface (see note 2).

4) Two positions on either side of the turntable centre such that the tip of the antenna will circumscribe a volume 0,75 m from the centre. These two positions are not required if the tip of the antenna extends to within 90 % of the total volume width when the antenna is positioned at the turntable centre. If the antenna elements overlap the centre at these two positions due to the length of the antenna, then the exact centre (position 1) need not be measured.

The antenna heights are based upon a maximum product height of approximately 2 m, and the use of a typical broadband antenna. Testing EUT's greater than 2 m in height or occupying areas greater than that circumscribed by the rotated 1 m x 1,5 m table may require higher transmit heights and larger antenna displacements from the centre of the turntable. NSA values other than those provided in this standard may be needed for some geometries (see clause A.2, reference [1]).

Assuming that the maximum horizontal extension of the EUT is 1,5 m, the minimum required number of horizontally polarized antenna measurements is four (two positions in the horizontal plane at two heights) (see figure A.2 (b)).

NOTES

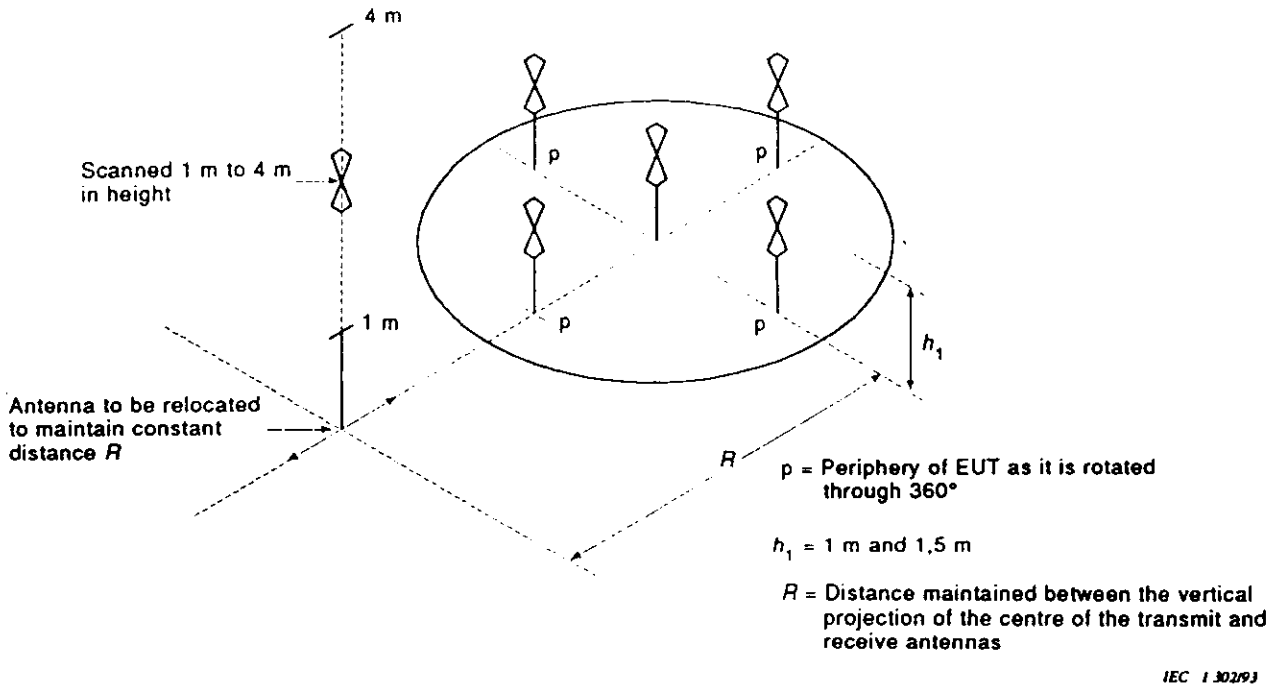
1 For sites without turntables, all references to the "centre" refer to the centre of the 1 m by 1,5 m test-table surface.

2 Sources located near dielectric interfaces have been shown to have variations in current distribution which can affect the radiation properties of the source at that location (see clause A.2, reference [3]). When located near these interfaces, an additional site attenuation measurement is required.

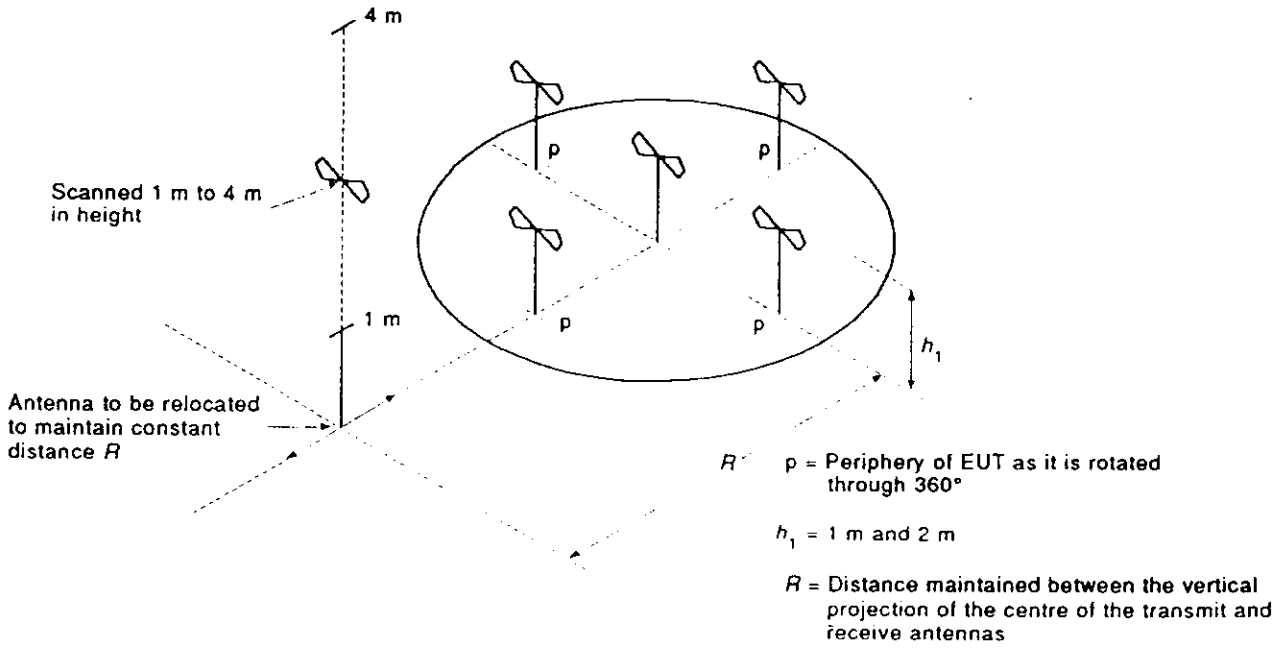
Table A.1 – Normalized site attenuation (A_N (dB)) for recommended geometries with broadband antennas

Polarization	Horizontal						Vertical				
R(m)	3	3	10	10	30	30	3	3	10	10	30
h_1(m)	1	2	1	2	1	2	1	1,5	1	1,5	1
h_2(m)	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4
f (MHz)	A_N (dB)										
30	15,8	11,0	29,8	24,1	47,7	41,7	8,2	9,3	16,7	16,9	26,0
35	13,4	8,8	27,1	21,6	45,0	39,1	6,9	8,0	15,4	15,6	24,7
40	11,3	7,0	24,9	19,4	42,7	36,8	5,8	7,0	14,2	14,4	23,5
45	9,4	5,5	22,9	17,5	40,7	34,7	4,9	6,1	13,2	13,4	22,5
50	7,8	4,2	21,1	15,9	38,8	32,9	4,0	5,4	12,3	12,5	21,6
60	5,0	2,2	18,0	13,1	35,7	29,8	2,6	4,1	10,7	11,0	20,0
70	2,8	0,6	15,5	10,9	33,0	27,2	1,5	3,2	9,4	9,7	18,7
80	0,9	−0,7	13,3	9,2	30,7	24,9	0,6	2,6	8,3	8,6	17,5
90	−0,7	−1,8	11,4	7,8	28,7	23,0	−0,1	2,1	7,3	7,6	16,5
100	−2,0	−2,8	9,7	6,7	26,9	21,2	−0,7	1,9	6,4	6,8	15,6
120	−4,2	−4,4	7,0	5,0	23,8	18,2	−1,5	1,3	4,9	5,4	14,0
125	−4,7	−4,7	6,4	4,6	23,1	17,6	−1,6	0,5	4,6	5,1	13,6
140	−6,0	−5,8	4,8	3,5	21,1	15,8	−1,8	−1,5	3,7	4,3	12,7
150	−6,7	−6,3	3,9	2,9	20,0	14,7	−1,8	−2,6	3,1	3,8	12,1
160	−7,4	−6,7	3,1	2,3	18,9	13,8	−1,7	−3,7	2,6	3,4	11,5
175	−8,3	−6,9	2,0	1,5	17,4	12,4	−1,4	−4,9	2,0	2,9	10,8
180	−8,6	−7,2	1,7	1,2	16,9	12,0	−1,3	−5,3	1,8	2,7	10,5
200	−9,6	−8,4	0,6	0,3	15,2	10,6	−3,6	−6,7	1,0	2,1	9,6
250	−11,7	−10,6	−1,6	−1,7	11,6	7,8	−7,7	−9,1	−0,5	0,3	7,7
300	−12,8	−12,3	−3,3	−3,3	8,7	6,1	−10,5	−10,9	−1,5	−1,9	6,2
400	−14,8	−14,9	−5,9	−5,8	4,5	3,5	−14,0	−12,6	−4,1	−5,0	3,9
500	−17,3	−16,7	−7,9	−7,6	1,8	1,6	−16,4	−15,1	−6,7	−7,2	2,1
600	−19,1	−18,3	−9,5	−9,3	0,0	0,0	−16,3	−16,9	−8,7	−9,0	0,8
700	−20,6	−19,7	−10,8	−10,6	−1,3	−1,4	−18,4	−18,4	−10,2	−10,4	−0,3
800	−21,3	−20,8	−12,0	−11,8	−2,5	−2,5	−20,0	−19,3	−11,5	−11,6	−1,1
900	−22,5	−21,8	−12,8	−12,9	−3,5	−3,5	−21,3	−20,4	−12,6	−12,7	−1,7
1 000	−23,5	−22,7	−13,8	−13,8	−4,5	−4,5	−22,4	−21,4	−13,6	−13,6	−3,6

NOTE – These data apply to antennas that have at least 250 mm of ground-plane clearance when the centre of the antenna is 1 m above the ground-plane in vertical polarization.

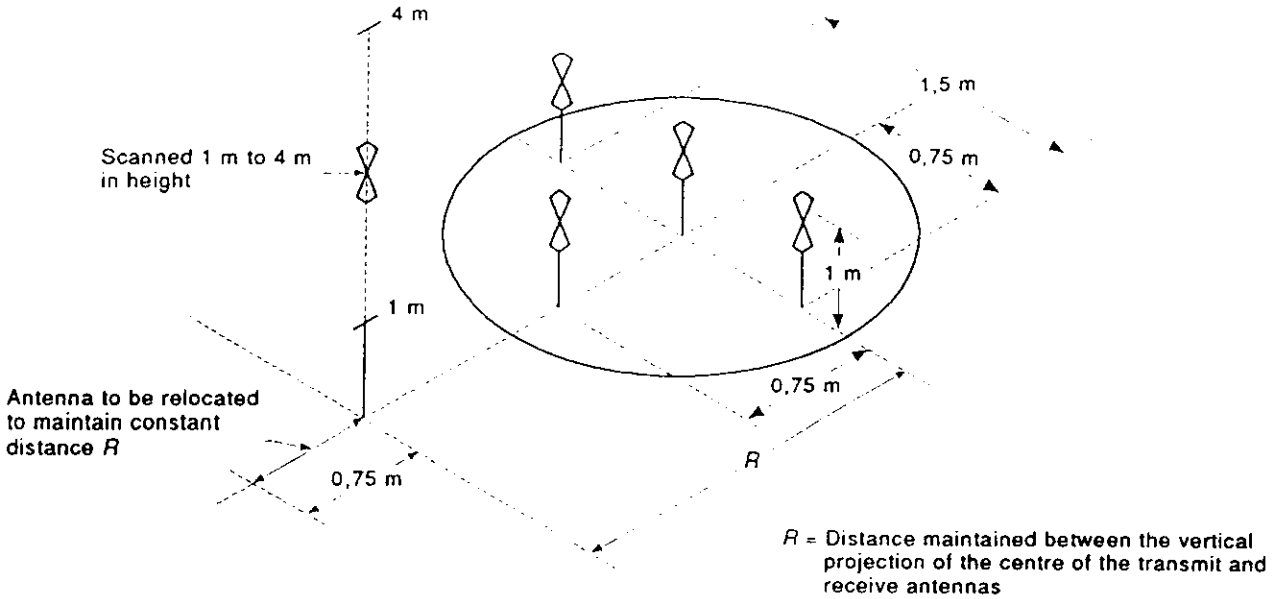


a) Typical antenna positions for alternate site NSA measurements in the vertical polarization

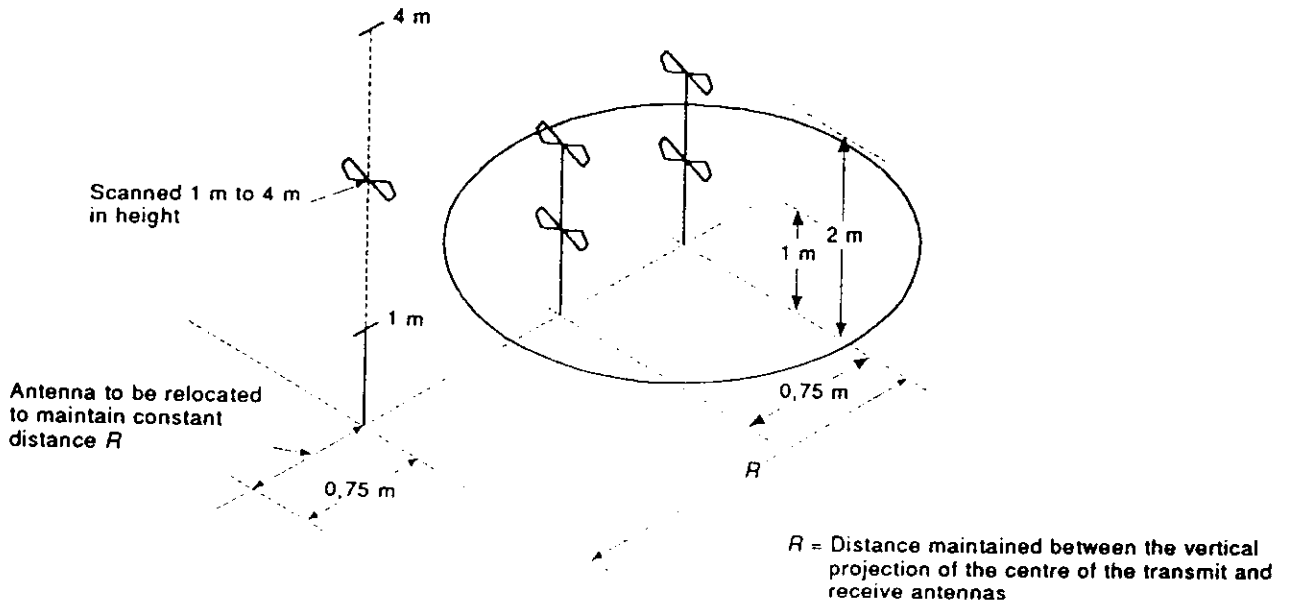


b) Typical antenna positions for alternate site NSA measurements in the horizontal polarization

Figure A.1 – Typical antenna positions for alternate site NSA measurements



a) Typical antenna positions for alternate site NSA measurements in the vertical polarization for a volume not to exceed 1 m depth, 1,5 m width and 1,5 m height and rear boundary of the volume greater than 1 m from the closest material that may cause undesirable reflections



b) Typical antenna positions for alternate site NSA measurements in the vertical polarization for a volume not to exceed 1 m depth, 1,5 m width and 1,5 m height and rear boundary of the volume greater than 1 m from the closest material that may cause undesirable reflections

Figure A.2 – Antenna positions for alternate site measurements for minimum recommended volume

A.2 References

[1] SMITH, A.A., GERMAN, R.F., PATE, J.B., "Calculation of site attenuation from antenna factors", IEEE Transactions on EMC, Vol EMC-24, 1982.

[2] GERMAN, R.F., "Comparison of semi-anechoic chamber and open-field site attenuation measurements", 1982 IEEE International Symposium Record on Electromagnetic Compatibility, pp 260-265.

[3] PATE, J.B., "Potential measurement errors due to mutual coupling between dipole antennas and radio frequency absorbing material in close proximity", 1984 IEEE National Symposium Record on Electromagnetic Compatibility.

Annex ZA (normative)

Other international publications quoted in this standard with the references of the relevant European publications

This European Standard incorporates by dated or undated reference, 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 European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE. When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Date	Title	EN/HD	Date
IEC 83	1975	*Plugs and socket-outlets for domestic and similar general use — Standards*	—	—
IEC 625	series	*An interface system for programmable measuring instruments (byte serial, bit parallel)*	HD 414	series
CISPR 11 (mod)	1990	*Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*	EN 55011	1991
CISPR 16	1987	*CISPR specification for radio interference measuring apparatus and measurement methods* NOTE. To be used until CISPR 16-2 is available.	—	—
CISPR 16-1	1993	*Specification for radio disturbance and immunity measuring apparatus and methods Part 1: Radio disturbance and immunity measuring apparatus*	—	—
CISPR 16-2	19XX	*Part 2: Methods of disturbance and immunity measurements* (under consideration)	—	—
CCITT V.24	1993	*List of definitions for interchange circuits, between data terminal equipment (DTE) and data circuit terminating equipment (DCE)*	—	—