IEC®

CISPR 16-1-4

Edition 4.0 2019-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

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

CISPR 16-1-4:2019-01(en-fr)

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

CISPR 16-1-4

Edition 4.0 2019-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE
COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.100.10; 33.100.20 ISBN 978-2-8322-6261-0

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD ... 8
1 Scope ... 10
2 Normative references ... 10
3 Terms, definitions and abbreviated terms ... 11
3.1 Terms and definitions ... 11
3.2 Abbreviated terms ... 15
4 Antennas for measurement of radiated radio disturbance ... 16
4.1 General ... 16
4.2 Physical parameter (measurand) for radiated disturbance measurements ... 16
4.3 Antennas for the frequency range 9 kHz to 150 kHz ... 17
4.3.1 General ... 17
4.3.2 Magnetic field antenna ... 17
4.3.3 Shielding of loop antenna ... 17
4.4 Antennas for the frequency range 150 kHz to 30 MHz ... 17
4.4.1 Electric field antenna ... 17
4.4.2 Magnetic field antenna ... 18
4.4.3 Balance and electric field discrimination of antennas ... 18
4.5 Antennas for the frequency range 30 MHz to 1 000 MHz ... 18
4.5.1 General ... 18
4.5.2 Low-uncertainty antenna for use if there is an alleged non-compliance to the electric disturbance field strength limit ... 18
4.5.3 Antenna characteristics ... 18
4.5.4 Balance of antenna ... 20
4.5.5 Cross-polar response of antenna ... 22
4.6 Antennas for the frequency range 1 GHz to 18 GHz ... 23
4.6.1 General ... 23
4.6.2 Receive antenna ... 23
4.7 Special antenna arrangements – large-loop antenna system ... 25
5 Test sites for measurement of radio disturbance field strength for the frequency range of 9 kHz to 30 MHz ... 25
6 Test sites for measurement of radio disturbance field strength for the frequency range of 30 MHz to 1 000 MHz ... 26
6.1 General ... 26
6.2 OATS ... 26
6.2.1 General ... 26
6.2.2 Weather-protection enclosure ... 26
6.2.3 Obstruction-free area ... 26
6.2.4 Radio-frequency ambient environment of a test site ... 27
6.2.5 Ground plane ... 28
6.3 Suitability of other test sites ... 28
6.3.1 Other ground-plane test sites ... 28
6.3.2 Test sites without ground plane (FAR) ... 28
6.4 Test site validations ... 29
6.4.1 General ... 29
6.4.2 Overview of test site validations ... 30
6.5 Basic parameters of the NSA method for OATS and SAC ... 30
6.5.1 General equation and table of theoretical NSA values ... 30

6.5.2 Antenna calibration 34
6.6 Reference site method for OATS and SAC 34
6.6.1 General 34
6.6.2 Antennas not permitted for RSM measurements 35
6.6.3 Determination of the antenna pair reference site attenuation on a REFTS 35
6.6.4 Determination of the antenna pair reference site attenuation using an averaging technique on a large OATS 36
6.7 Validation of an OATS by the NSA method 39
6.7.1 Discrete frequency method 39
6.7.2 Swept frequency method 40
6.8 Validation of a weather-protection-enclosed OATS or a SAC 41
6.9 Possible causes for exceeding site acceptability limits 43
6.10 Site validation for FARs 44
6.10.1 General 44
6.10.2 RSM for FAR sites 48
6.10.3 NSA method for FAR sites 50
6.10.4 Site validation criteria for FAR sites 52
6.11 Evaluation of set-up table and antenna tower 52
6.11.1 General 52
6.11.2 Evaluation procedure for set-up table influences 53
7 Test sites for measurement of radio disturbance field strength for the frequency range 1 GHz to 18 GHz 54
7.1 General 54
7.2 Reference test site 55
7.3 Test site validation 55
7.3.1 General 55
7.3.2 Acceptance criterion for site validation 56
7.4 Antenna requirements for S_{VSWR} standard test procedure 56
7.4.1 General 56
7.4.2 Transmit antenna 57
7.4.3 Antennas and test equipment for the S_{VSWR} reciprocal test procedure 59
7.5 Required positions for site validation testing 60
7.5.1 General 60
7.5.2 Descriptions of S_{VSWR} measurement positions in a horizontal plane (Figure 23) 60
7.5.3 Descriptions of S_{VSWR} additional measurement positions (Figure 24) 61
7.5.4 Summary of S_{VSWR} measurement positions 62
7.6 S_{VSWR} site validation – standard test procedure 65
7.7 S_{VSWR} site validation – reciprocal test procedure using an isotropic field probe 66
7.8 S_{VSWR} conditional measurement position requirements 67
7.9 S_{VSWR} site validation test report 68
7.10 Limitations of the S_{VSWR} site validation method 68
7.11 Alternative test sites 69
8 Common mode absorption devices 69
8.1 General 69
8.2 CMAD S-parameter measurements 69
8.3 CMAD test jig 69
8.4 Measurement method using the TRL calibration 70

8.5 Specification of ferrite clamp-type CMAD 72
8.6 CMAD performance (degradation) check using spectrum analyzer and tracking generator 73
9 Reverberating chamber for total radiated power measurement 75
9.1 General 75
9.2 Chamber 75
9.2.1 Chamber size and shape 75
9.2.2 Door, openings in walls, and mounting brackets 75
9.2.3 Stirrers 76
9.2.4 Test for the efficiency of the stirrers 76
9.2.5 Coupling attenuation 77
10 TEM cells for immunity to radiated disturbance measurement 78
Annex A (normative) Parameters of antennas 79
A.1 General 79
A.2 Preferred antennas 79
A.2.1 General 79
A.2.2 Calculable antenna 79
A.2.3 Low-uncertainty antennas 79
A.3 Simple dipole antennas 80
A.3.1 General 80
A.3.2 Tuned dipole 81
A.3.3 Shortened dipole 81
A.4 Broadband antenna parameters 82
A.4.1 General 82
A.4.2 Antenna type 83
A.4.3 Specification of the antenna 83
A.4.4 Antenna calibration 84
A.4.5 Antenna user information 84
Annex B (XXX) (Void) 85
Annex C (normative) Large-loop antenna system for magnetic field induced-current measurements in the frequency range of 9 kHz to 30 MHz 86
C.1 General 86
C.2 Construction of an LLAS 86
C.3 Construction of a large-loop antenna (LLA) 86
C.4 Validation of an LLA 91
C.5 Construction of the LLAS verification dipole antenna 92
C.6 Conversion factors 93
Annex D (normative) Construction details for open area test sites in the frequency range of 30 MHz to 1 000 MHz (see Clause 6) 96
D.1 General 96
D.2 Ground plane construction 96
D.2.1 Material 96
D.2.2 Roughness 96
D.3 Services to EUT 97
D.4 Weather-protection enclosure construction 97
D.4.1 Materials and fasteners 97
D.4.2 Internal arrangements 98
D.4.3 Size 98
D.4.4 Uniformity with time and weather 98

D.5 Turntable and set-up table ... 98
D.6 Receive antenna mast installation ... 99
Annex E (xxx) (Void) ... 100
Annex F (informative) Basis for ± 4 dB site acceptability criterion (see Clause 6) ... 101
F.1 General ... 101
F.2 Error analysis ... 101
Annex G (informative) Examples of uncertainty budgets for site validation of a COMTS using RSM with a calibrated antenna pair (see 6.6) ... 103
G.1 Quantities to be considered for antenna pair reference site attenuation calibration using the averaging technique ... 103
G.2 Quantities to be considered for antenna pair reference site attenuation calibration using a REFTS ... 104
G.3 Quantities to be considered for COMTS validation using an antenna pair reference site attenuation ... 105
Bibliography ... 106

Figure 1 – Schematic of radiation from EUT reaching an LPDA antenna directly and via ground reflections at a 3 m site, showing the beamwidth half-angle, φ, at the reflected ray ... 19
Figure 2 – RX antenna E-plane radiation pattern example, with limit area shaded for 3 m distance and 2 m EUT width ... 24
Figure 3 – Determination of maximum useable EUT width using half-power beamwidth ... 24
Figure 4 – Determination of maximum useable EUT height using half-power beamwidth ... 25
Figure 5 – Obstruction-free area of a test site with a turntable (see 6.2.3) ... 27
Figure 6 – Obstruction-free area with stationary EUT (see 6.2.3) ... 27
Figure 7 – Test point locations for 3 m and 10 m test distances ... 36
Figure 8 – Paired test point locations for all test distances ... 38
Figure 9 – Example of paired test point selection for a test distance of 10 m ... 38
Figure 10 – Illustration of an investigation of influence of antenna mast on A_{APR} ... 39
Figure 11 – Typical antenna positions for a weather-protected OATS or a SAC – vertical polarization validation measurements ... 42
Figure 12 – Typical antenna positions for a weather-protected OATS or a SAC – horizontal polarization validation measurements ... 42
Figure 13 – Typical antenna positions for a weather-protected OATS or a SAC – vertical polarization validation measurements for a smaller EUT ... 43
Figure 14 – Typical antenna positions for a weather-protected OATS or a SAC – horizontal polarization validation measurements for a smaller EUT ... 43
Figure 15 – Measurement positions for FAR site validation ... 46
Figure 16 – Example of one measurement position and antenna tilt for FAR site validation ... 48
Figure 17 – Typical quasi free-space test site reference SA measurement set-up ... 50
Figure 18 – Theoretical free-space NSA as a function of frequency for different measurement distances [see Equation (16)] ... 52
Figure 19 – Position of the antenna relative to the edge above a rectangle set-up table (top view) ... 54
Figure 20 – Antenna position above the set-up table (side view) ... 54
Figure 21 – Transmit antenna E-plane radiation pattern example (this example is for informative purposes only) ... 58
Figure 22 – Transmit antenna H-plane radiation pattern (this example is for informative purposes only) ... 59

Figure 23 – S_{VSWR} measurement positions in a horizontal plane (see 7.5.2 for description) ... 60
Figure 24 – S_{VSWR} positions (height requirements) ... 62
Figure 25 – S_{VSWR} conditional measurement position requirements ... 68
Figure 26 – Definition of the reference planes inside the test jig ... 70
Figure 27 – The four configurations for the TRL calibration ... 72
Figure 28 – Limits for the magnitude of S_{11}, measured according to the provisions of 8.1 to 8.3 ... 73
Figure 29 – Example of a 50 Ω adaptor construction in the vertical flange of the jig ... 74
Figure 30 – Example of a matching adaptor with balun or transformer ... 74
Figure 31 – Example of a matching adaptor with resistive matching network ... 75
Figure 32 – Example of a typical paddle stirrer ... 76
Figure 33 – Range of coupling attenuation as a function of frequency for a chamber using the stirrer shown in Figure 16 ... 77
Figure A.1 – Short dipole antenna factors for R_L = 50 Ω ... 82
Figure C.1 – The LLAS, consisting of three mutually perpendicular large-loop antennas ... 88
Figure C.2 – An LLA containing two opposite slits, positioned symmetrically with respect to the current probe C ... 89
Figure C.3 – Construction of an LLA slit ... 89
Figure C.4 – Example of an LLA slit construction using a strap of printed circuit board to obtain a rigid construction ... 90
Figure C.5 – Construction of the metal box containing the current probe ... 90
Figure C.6 – Example showing the routing of several cables from an EUT to minimize capacitive coupling from the leads to the LLAS ... 91
Figure C.7 – The eight positions of the LLAS verification dipole during validation of an LLA ... 92
Figure C.8 – Validation factor for an LLA of 2 m diameter ... 92
Figure C.9 – Construction of the LLAS verification dipole antenna ... 93
Figure C.10 – Conversion factors C_{dA} [for conversion into dB(μA/m)] and C_{dV} [for conversion into dB(μV/m)] for two standard measuring distances d ... 95
Figure C.11 – Sensitivity S_D of a large-loop antenna with diameter D relative to a large-loop antenna having a diameter of 2 m ... 95
Figure D.1 – The Rayleigh criterion for roughness in the ground plane ... 97

Table 1 – Site validation methods applicable for OATS, OATS-based, SAC, and FAR site types ... 29
Table 2 – Theoretical normalized site attenuation, A_N – recommended geometries for broadband antennas ... 32
Table 3 – Example template for A_{APR} data sets ... 35
Table 4 – RSM frequency steps ... 35
Table 5 – Maximum dimensions of test volume versus test distance ... 44
Table 6 – Frequency ranges and step sizes for FAR site validation ... 48
Table 7 – S_{VSWR} measurement position designations ... 63
Table 8 – S_{VSWR} reporting requirements ... 68
Table D.1 – Maximum roughness for 3 m, 10 m and 30 m measurement distances ... 97
Table F.1 – Error budget ... 101

Table G.1 – Antenna pair reference site attenuation calibration using the large-OATS averaging technique 103
Table G.2 – Antenna pair reference site attenuation calibration using REFTS 104
Table G.3 – COMTS validation using an antenna pair reference site attenuation 105

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

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights

This fourth edition cancels and replaces the third edition published in 2010, Amendment 1:2012 and Amendment 2:2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- provisions are added to address test site validation in the frequency range from 30 MHz to 1000 MHz using the reference site method, to take into account the receive antenna radiation pattern in the frequency range from 1 GHz to 18 GHz, and further details on test site validation using the NSA method with broadband antennas in the frequency range from 30 MHz to 1 000 MHz.

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

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.*

The text of this International Standard is based on the following documents:

FDIS	Report on voting
CIS/A/1262/FDIS	CIS/A/1275/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 cooperate 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, further information on radio disturbance is given in Part 3, and uncertainties, statistics and limit modelling are covered in Part 4 of CISPR 16.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 16-1-5:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-5: Radio disturbance and immunity measuring apparatus – Antenna calibration sites and reference test sites for 5 MHz to 18 GHz*
CISPR 16-1-5:2014/AMD1:2016

CISPR 16-1-6:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-6: Radio disturbance and immunity measuring apparatus – EMC antenna calibration*
CISPR 16-1-6:2014/AMD1:2017

CISPR 16-2-3:2016, *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, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 3: CISPR technical reports*

CISPR 16-4-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Measurement instrumentation uncertainty*

IEC 60050-161, *International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in CISPR 16-1-1, CISPR 16-1-5, IEC 60050-161 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
antenna
transducer that converts the guided electromagnetic energy of the feed line into a radiated wave in space and vice versa

Note 1 to entry: In the context of this document, for antennas for which a balun is intrinsic to the functioning of the antenna, the term "antenna" includes the balun.

3.1.2
antenna factor
AF
F_a
ratio of the electric field strength of a plane wave incident from the direction corresponding to the mechanical boresight (i.e. the main axis of the antenna) to the voltage induced across a specified load connected to the antenna, measured in a free-space environment

Note 1 to entry: The abbreviation AF is used as a general term to denote antenna factor, whereas F_a denotes the boresight AF in free-space. AF is affected by the load impedance (typically 50 Ω) connected to the antenna, and is frequency dependent. For a biconical antenna this impedance could be up to 200 Ω. For antennas with no balun the impedance is equal to the load impedance, typically 50 Ω. AF can be affected by mutual coupling of the antenna to the ground plane, and is directivity dependent. For more details see the definitions and 4.2 in CISPR 16-1-6:2014.

Note 2 to entry: The AF has the physical dimension of m^{-1} and measured data are normally expressed in dB relative to 1/m [dB(m^{-1})]. In radiated disturbance measurements, if F_a is known, the strength of an incident field, E, can be estimated from a reading, V, of a measuring receiver connected to the antenna as follows:

$$E = V + F_a$$

where E is in dB(μV/m), V is in dB(μV) and F_a is in dB(m^{-1}).

3.1.3
antenna pair reference site attenuation
A_{APR}
set of site attenuation measurement results for both vertical and horizontal polarizations using a pair of antennas separated by a defined distance at an ideal open-area test site, with one antenna at a specified fixed height above the ground plane, and the other antenna scanned over a specified height range in which the minimum insertion loss is recorded

Note 1 to entry: A_{APR} is an influence quantity for uncertainty calculation of site validation measurements using RSM.

Note 2 to entry: A_{APR} measurements are used for comparison to corresponding site attenuation measurements of a COMTS to evaluate the performance of the COMTS.

3.1.4
antenna reference point
midpoint of an antenna from which the distance to the EUT or second antenna is measured

Note 1 to entry: The antenna reference point is either defined by the manufacturer using a marker on LPDA antennas or by the calibration laboratory.

3.1.5
balun
device for transforming an unbalanced transmission line to a balanced transmission line and vice versa

Note 1 to entry: A balun is used, for example, to couple balanced antenna elements to an unbalanced feed line, such as a coaxial cable. A balun may exhibit inherent impedance transformation differing from unity.

3.1.6
calibration test site
CALTS
open area test site with metallic ground plane and tightly specified site attenuation performance in horizontal electric field polarization

Note 1 to entry: A CALTS is used for determining the free-space antenna factor of an antenna.

3.1.7
common mode absorption device
CMAD
device that may be applied on cables leaving the test volume in radiated disturbance measurements to reduce the compliance uncertainty

3.1.8
compliance test site
COMTS
environment that assures valid, reproducible measurement results of the disturbance field strength from equipment under test for comparison to a compliance limit

3.1.9
cross-polar response
XPR
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

3.1.10
EUT volume
cylinder defined by EUT boundary diameter and height that fully encompasses all portions of the actual EUT, including cable racks and 1,6 m of cable length (30 MHz to 1 GHz) and 0,3 m of cable length (1 GHz and above)

Note 1 to entry: The test volume is one of several criteria limiting the EUT volume (see CISPR 16-2-3).

Note 2 to entry: The EUT volume has a diameter D (boundary diameter) and height h.

3.1.11
fully-anechoic room
FAR
an enclosure, the six internal surfaces of which are lined with radio-frequency-energy absorbing material (i.e. RF absorber) that attenuates electromagnetic energy in the frequency range of interest

Note 1 to entry: For general radiated disturbance measurement purposes, a FAR should be constructed inside a shielded enclosure.

3.1.12
hybrid antenna
antenna consisting of a wire-element log-periodic dipole array (LPDA) section and a broadband dipole section

Note 1 to entry: The longest element of the LPDA section is typically resonant at approximately 200 MHz, and the boom is lengthened at the open-circuit end to feed the connected broadband dipole (e.g. biconical or bowtie) section. Over the range 30 MHz to 200 MHz, the broadband dipole exhibits a performance similar to a biconical antenna, notably in the variation of height-dependent antenna factor.

Note 2 to entry: A common-mode choke is typically used at the open-circuit (i.e. rear) end of the boom to minimize parasitic (unintended) RF currents on the outer conductor of the coaxial cable flowing into the measuring receiver.

3.1.13
ideal open-area test site
open-area test site having a perfectly flat, perfectly conducting ground plane of infinite area, and with no reflecting objects except the ground plane

Note 1 to entry: An ideal OATS is a theoretical construct that is used in the definition of the measurand A_{APR} and in the calculation of the theoretical normalized site attenuation A_{N} for ground plane sites.

3.1.14
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

Note 1 to entry: Insertion loss is equal to the inverse of the transmission S-parameter, i.e. $|1/S_{21}|$.

3.1.15
low-uncertainty antenna
robust biconical or LPDA antenna that meets the balance and XPR requirements of this document, and whose antenna factor has an uncertainty of less than 0,5 dB, used for the measurement of electric field strength at a defined point in space

Note 1 to entry: Low-uncertainty antennas are further described in A.2.3.

3.1.16
mechanical boresight
boresight direction
boresight
direction of the main beam, which is defined by the geometric properties of the antenna

Note 1 to entry: For EMC antennas the direction of the main beam is usually: a) coincident with the direction in line with the mechanical longitudinal axis of LPDA antennas; b) orthogonal to the elements of monopole, dipole, and biconical antennas; and c) orthogonal to the front aperture of horn antennas. In each of these cases, the orthogonal line is coincident with the centre of the antenna.

3.1.17
null
minimum in signal level resulting from the vector sum of the direct and ground-reflected signals at the receive antenna and with the level being considerably lower than the in-phase sum of these signals

Note 1 to entry: The depth of a null is measured from the in-phase sum of the direct and ground reflected signals. A null in the received signal occurs when the antennas are above a ground plane at heights such that the direct and ground reflected signals are in anti-phase, which can result in large uncertainty in the measurement of field strength. A null extends from 90° to 180° out of phase. At 90° the null depth is approximately 6 dB. The depth is compared to the nearest adjacent maximum signal in the swept frequency response (or height scan of one antenna at a fixed frequency).