CISPR 16-2-1

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Specification for radio disturbance and immunity measuring apparatus and methods –
Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements

Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques –
Partie 2-1: Méthodes de mesure des perturbations et de l'immunité – Mesures des perturbations conduites

CISPR 16-2-1:2008+A1:2010

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FOREWORD

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This consolidated version of CISPR 16-2-1 consists of the second edition (2008) [documents CISPR/A/798/FDIS and CISPR/A/809/RVD and its amendment 1 (2010) [documents CISPR/A/874/CDV and CISPR/A/897/RVC]. It bears the edition number 2.1.

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

International Standard CISPR 16-2-1 has been prepared by CISPR subcommittee A: Radio interference measurements and statistical methods.

This edition includes significant technical changes with respect to the previous edition. In general, this new edition aims at reducing compliance uncertainty in correspondence with findings in CISPR 16-4-1. Guidelines are given on

– resonance-free connection of the AMN to reference ground,
– avoidance of ground loops, and
– avoidance of ambiguities of the test setup of EUT and AMN with respect to the reference ground plane.

In addition, terms are clarified, a new type of ancillary equipment (CVP) is applied, and a clarification for the use of the AAN and AMN on the same EUT is provided.

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 publication using a colour printer.

INTRODUCTION
(to amendment 1)

All stated specifications in CISPR 16-2-1 are met by an instrument independent of the selected implementation or technology in order to be considered suitable for measurements in accordance with CISPR standards. The addition of FFT-based measuring instrumentation requires further specifications as addressed in this amendment. A new Annex F is added as a result of provisions recently introduced into CISPR 16-1-1 on the use of spectrum analyzers for compliance measurements.

SPECIFICATION FOR RADIO DISTURBANCE AND IMMUNITY MEASURING APPARATUS AND METHODS –

Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements

1 Scope

This part of CISPR 16 is designated a basic standard, which specifies the methods of measurement of disturbance phenomena in general in the frequency range 9 kHz to 18 GHz and especially of conducted disturbance phenomena in the frequency range 9 kHz to 30 MHz.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic Compatibility*

IEC 60364-4 (all parts), *Electrical installations of buildings – Part 4: Protection for safety*

CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 16-1-1:2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

~~CISPR/TR 16-3:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 3: CISPR technical reports*~~
~~Amendment 1:2005~~
~~Amendment 2:2006~~

3 Definitions

For the purposes of this part of CISPR 16, the definitions of IEC 60050-161 apply, as well as the following.

3.1
ancillary equipment
transducers (e.g., current and voltage probes and artificial networks) connected to a measuring receiver or (test) signal generator and used in the disturbance signal transfer between the EUT and the measuring or test equipment

3.2
associated equipment
AE
apparatus, which is not part of the system under test, but needed to help exercise the EUT

3.3
auxiliary equipment
AuxEq
peripheral equipment which is part of the system under test

3.4
EUT
equipment (devices, appliances and systems) subjected to EMC (emission) compliance tests

3.5
product publication
publication specifying EMC requirements for a product or product family, taking into account specific aspects of such a product or product family

3.6
emission limit (from a disturbing source)
specified maximum emission level of a source of electromagnetic disturbance

[IEV 161-03-12]

3.7
~~**ground reference**~~
~~connection that constitutes a defined parasitic capacitance to the surrounding of an EUT and serves as reference potential~~

~~NOTE See also IEV 161-04-36 (modified).~~

reference ground plane
RGP
flat conductive surface that constitutes a defined parasitic capacitance to the surrounding of an EUT and serves as reference potential

NOTE 1 See also IEC 60050-161, 161-04-36.

NOTE 2 A reference ground plane is needed for conducted emission measurements, and serves as reference ground for unsymmetrical and asymmetrical disturbance voltage measurements.

3.8
(electromagnetic) emission
phenomenon by which electromagnetic energy emanates from a source

[IEV 161-01-08]

3.9
coaxial cable
cable containing one or more coaxial lines, typically used for a matched connection of associated equipment to the measuring equipment or (test-)signal generator providing a specified characteristic impedance and a specified maximum allowable cable transfer impedance

3.10
common mode (asymmetrical) voltage
RF voltage between the artificial midpoint of a two-conductor line and reference ground, or in case of a bundle of lines, the effective RF disturbance voltage of the whole bundle (vector sum of the unsymmetrical voltages) against the reference ground measured with a clamp (current transformer) at a defined terminating impedance

NOTE See also IEV 161-04-09.

3.11
common mode current
vector sum of the currents flowing through two or more conductors at a specified cross-section of a "mathematical" plane intersected by these conductors

3.12
differential mode (symmetrical) voltage
RF disturbance voltage between the wires of a two conductor line

[IEV 161-04-08, modified]

3.13
differential mode current
half the vector difference of the currents flowing in any two of a specified set of active conductors at a specified cross-section of a "mathematical" plane intersected by these conductors

3.14
unsymmetrical mode (V-terminal) voltage
voltage between a conductor or terminal of a device, equipment or system and a specified ground reference. For the case of a two-port network, the two unsymmetrical voltages are given by:

a) the vector sum of the asymmetrical voltage and half of the symmetrical voltage; and
b) the vector difference between the asymmetrical voltage and half of the symmetrical voltage.

NOTE See also IEV 161-04-13.

3.15
measuring receiver
~~receiver for the measurement of disturbances with different detectors~~

~~NOTE The receiver is specified according to CISPR 16-1-1.~~

instrument such as a tunable voltmeter, an EMI receiver, a spectrum analyzer or an FFT-based measuring instrument, with or without preselection, that meets the relevant clauses of CISPR 16-1-1

NOTE See Annex I of CISPR 16-1-1 for further information.

3.16
test configuration
combination that gives the specified measurement arrangement of the EUT in which an emission level is measured

~~NOTE The emission and immunity levels are measured as required by IEV 161-03-11, IEV 161-03-12, IEV 161-03-14 and IEV 161-03-15, definitions of emission level.~~

3.17
artificial network
AN
agreed reference load (simulation) impedance presented to the EUT by actual networks (e.g., extended power or communication lines) across which the RF disturbance voltage is measured

3.18
artificial mains network
AMN
network inserted in the supply mains lead of apparatus to be tested which provides, in a given frequency range, a specified load impedance for the measurement of disturbance voltages and which may isolate the apparatus from the supply mains in that frequency range

[IEV 161-04-05]

NOTE There are two basic types of AMN, the V-network (V-AMN) which couples the unsymmetrical voltages, and the delta-network which couples the symmetric and the asymmetric voltages separately. The terms line impedance stabilization network (LISN) and V-AMN are used interchangeably. In this standard, the acronym "AMN" is used for "V-AMN", as delta-AMNs are not used in product publications on emission measurements.

3.19
~~**weighting (quasi-peak detection)**~~
~~repetition-rate dependent conversion of the peak-detected pulse voltages to an indication corresponding to the psychophysical annoyance of pulsive disturbances (acoustically or visually) according to the weighting characteristics, or alternatively, specified manner in which an emission level or an immunity level is evaluated~~

~~NOTE 1 The weighting characteristics are specified in CISPR 16-1-1.~~

~~NOTE 2 The emission level or immunity level is evaluated as required by IEC 60050-161 definitions of level (see IEV 161-03-01, IEV 161-03-11 and IEV 161-03-14).~~

weighting (of e.g. impulsive disturbance)
pulse-repetition-frequency (PRF) dependent conversion (mostly reduction) of a peak-detected impulse voltage level to an indication that corresponds to the interference effect on radio reception

NOTE 1 For the analogue receiver, the psychophysical annoyance of the interference is a subjective quantity (audible or visual, usually not a certain number of misunderstandings of a spoken text).

NOTE 2 For the digital receiver, the interference effect is an objective quantity that may be defined by the critical bit error ratio (BER) or bit error probability (BEP) for which perfect error correction can still occur or by another, objective and reproducible parameter.

3.19.1
weighted disturbance measurement
measurement of disturbance using a weighting detector

3.19.2
weighting characteristic
peak voltage level as a function of PRF for a constant effect on a specific radiocommunication system, i.e. the disturbance is weighted by the radiocommunication system itself

3.19.3
weighting detector
detector that provides an agreed weighting function

3.19.4
weighting factor
value of the weighting function relative to a reference PRF or relative to the peak value

NOTE Weighting factor is expressed in dB.

3.19.5
weighting function
weighting curve
relationship between input peak voltage level and PRF for constant level indication of a measuring receiver with a weighting detector, i.e. the curve of response of a measuring receiver to repeated pulses

3.20
continuous disturbance
RF disturbance with a duration of more than 200 ms at the IF-output of a measuring receiver, which causes a deflection on the meter of a measuring receiver in quasi-peak detection mode which does not decrease immediately

[IEV 161-02-11, modified]

~~NOTE The measuring receiver is specified in CISPR 16-1-1.~~

3.21
discontinuous disturbance
for counted clicks, disturbance with a duration of less than 200 ms at the IF-output of a measuring receiver, which causes a transient deflection on the meter of a measuring receiver in quasi-peak detection mode

NOTE For impulsive disturbance, see IEV 161-02-08.

~~NOTE 2 The measuring receiver is specified in CISPR 16-1-1.~~

3.22
measurement time
T_m
effective, coherent time for a measurement result at a single frequency (in some areas also called dwell time)

– for the peak detector, the effective time to detect the maximum of the signal envelope,
– for the quasi-peak detector, the effective time to measure the maximum of the weighted envelope
– for the average detector, the effective time to average the signal envelope
– for the r.m.s. detector, the effective time to determine the r.m.s. of the signal envelope

3.23
sweep
continuous frequency variation over a given frequency span

3.24
scan
continuous or stepped frequency variation over a given frequency span

3.25
sweep or scan time
T_s
time between start and stop frequencies of a sweep or scan

3.26
span
Δf
difference between stop and start frequencies of a sweep or scan

3.27
sweep or scan rate
frequency span divided by the sweep or scan time