

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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**



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CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references.....	8
3 Definitions.....	8
4 Types of disturbance to be measured.....	12
4.1 General.....	12
4.2 Types of disturbance.....	12
4.3 Detector functions.....	12
5 Connection of measuring equipment.....	13
5.1 General.....	13
5.2 Connection of ancillary equipment.....	13
5.3 Connections to RF reference ground.....	13
5.4 Connection between the EUT and the artificial mains network.....	14
6 General measurement requirements and conditions.....	15
6.1 General.....	15
6.2 Disturbance not produced by the equipment under test.....	15
6.2.1 General.....	15
6.2.2 Compliance testing.....	15
6.3 Measurement of continuous disturbance.....	15
6.3.1 Narrowband continuous disturbance.....	15
6.3.2 Broadband continuous disturbance.....	15
6.3.3 Use of spectrum analyzers and scanning receivers.....	16
6.4 Operating conditions of the EUT.....	16
6.4.1 General.....	16
6.4.2 Normal load conditions.....	16
6.4.3 Duration of operation.....	16
6.4.4 Running-in/Warm-up time.....	16
6.4.5 Supply.....	16
6.4.6 Mode of operation.....	16
6.5 Interpretation of measuring results.....	16
6.5.1 Continuous disturbance.....	16
6.5.2 Discontinuous disturbance.....	17
6.5.3 Measurement of the duration of disturbances.....	17
6.6 Measurement times and scan rates for continuous disturbance.....	17
6.6.1 General.....	17
6.6.2 Minimum measurement times.....	17
6.6.3 Scan rates for scanning receivers and spectrum analyzers.....	18
6.6.4 Scan times for stepping receivers.....	19
6.6.5 Strategies for obtaining a spectrum overview using the peak detector.....	20
7 Measurement of disturbances conducted along leads, 9 kHz to 30 MHz.....	23
7.1 Introduction.....	23
7.2 Measuring equipment (receivers, etc.).....	23
7.2.1 General.....	23
7.2.2 Use of detectors for conducted disturbance measurements.....	23
7.3 Ancillary measuring equipment.....	24
7.3.1 General.....	24

7.3.2	Artificial networks (AN).....	24
7.3.3	Voltage probes.....	25
7.3.4	Current probes.....	25
7.4	Equipment under test configuration.....	25
7.4.1	Arrangement of the EUT and its connection to the AN.....	25
7.4.2	Procedure for the measurement of unsymmetric disturbance voltages with V-networks (AMNs).....	31
7.4.3	Measurement of common mode voltages at differential mode signal terminals.....	38
7.4.4	Measurements using voltage probes.....	39
7.4.5	Measurement using a capacitive voltage probe (CVP).....	41
7.4.6	Measurements using current probes.....	41
7.5	System test configuration for conducted emissions measurements.....	42
7.5.1	General approach to system measurements.....	42
7.5.2	System configuration.....	42
7.5.3	Measurements of interconnecting lines.....	45
7.5.4	Decoupling of system components.....	45
7.6	<i>In situ</i> measurements.....	45
7.6.1	General.....	45
7.6.2	Reference ground.....	46
7.6.3	Measurement with voltage probes.....	46
7.6.4	Selection of measuring points.....	46
8	Automated measurement of emissions.....	47
8.1	Introduction: Precautions for automating measurements.....	47
8.2	Generic measurement procedure.....	47
8.3	Prescan measurements.....	48
8.4	Data reduction.....	49
8.5	Emission maximization and final measurement.....	49
8.6	Post processing and reporting.....	49
	Annex A (informative) Guidelines to connection of electrical equipment to the artificial mains network (see Clause 5).....	50
	Annex B (informative) Use of spectrum analyzers and scanning receivers (see Clause 6).....	57
	Annex C (informative) Decision tree for use of detectors for conducted measurements (see 7.2.2).....	60
	Annex D (informative) Scan rates and measurement times for use with the average detector.....	62
	Annex E (informative) Guidelines for the improvement of the test setup with ANs.....	66
	Bibliography.....	72
	Figure 1 – Example of a recommended test setup with PE chokes with three AMNs and a sheath current absorber on the RF cable.....	14
	Figure 2 – Measurement of a combination of a CW signal (“NB”) and an impulsive signal (“BB”) using multiple sweeps with maximum hold.....	20
	Figure 3 – Example of a timing analysis.....	21
	Figure 4 – A broadband spectrum measured with a stepped receiver.....	22
	Figure 5 – Intermittent narrowband disturbances measured using fast short repetitive sweeps with maximum hold function to obtain an overview of the emission spectrum.....	22
	Figure 6 – Test configuration: table-top equipment for conducted disturbance measurements on power mains.....	26

Figure 7 – Arrangement of EUT and AMN at 40 cm distance with a) vertical RGP and b) horizontal RGP.....	27
Figure 8 – Optional example test configuration for an EUT with only a power cord attached.....	28
Figure 9 – Test configuration: floor-standing equipment (see 7.4.1 and 7.5.2.2).....	29
Figure 10 – Example Test configuration: floor-standing and table-top equipment (see 7.4.1 and 7.5.2.2).....	30
Figure 11 – Schematic of disturbance voltage measurement configuration (see also 7.5.2.2).....	32
Figure 12a – Schematic for measurement and power circuit.....	33
Figure 12b – Equivalent voltage source and measurement circuit.....	33
Figure 12 – Equivalent circuit for measurement of common mode disturbance voltage for class I (grounded) EUT.....	33
Figure 13a – Schematic for power and measurement circuit.....	34
Figure 13b – Equivalent RFI source and measurement circuit.....	34
Figure 13 – Equivalent circuit for measurement of common mode disturbance voltage for class II (ungrounded) EUT.....	34
Figure 14 – RC element for artificial hand.....	36
Figure 15 – Portable electric drill with artificial hand.....	36
Figure 16 – Portable electric saw with artificial hand.....	36
Figure 17 – Measuring example for voltage probes.....	40
Figure 18 – Measurement arrangement for two-terminal regulating controls.....	40
Figure A.1.....	50
Figure A.2.....	51
Figure A.3.....	51
Figure A.4.....	51
Figure A.5.....	52
Figure A.6.....	52
Figure A.7.....	53
Figure A.8 – AMN configurations.....	55
Figure C.1 – Decision tree for optimizing speed of conducted disturbance measurements with peak, quasi-peak and average detectors.....	60
Figure D.1 – Weighting function of a 10 ms pulse for peak (“PK”) and average detections with (“CISPR AV”) and without (“AV”) peak reading; meter time constant 160 ms.....	64
Figure D.2 – Weighting functions of a 10 ms pulse for peak (“PK”) and average detections with (“CISPR AV”) and without (“AV”) peak reading; meter time constant 100 ms.....	64
Figure D.3 – Example of weighting functions (of a 1 Hz pulse) for peak (“PK”) and average detections as a function of pulse width: meter time constant 160 ms.....	65
Figure D.4 – Example of weighting functions (of a 1 Hz pulse) for peak (“PK”) and average detections as a function of pulse width: meter time constant 100 ms.....	65
Figure E.1 – Parallel resonance of enclosure capacitance and ground strap inductance.....	66
Figure E.2 – Connection of an AMN to RGP using a wide grounding sheet for low inductance grounding.....	67
Figure E.3 – Impedance measured with the arrangement of Figure E.2 both with reference to the front panel ground and to the grounding sheet.....	67

Figure E.4 – VDF in the configuration of Figure E.2 measured with reference to the front panel ground and to the grounding sheet. (The AMN used has a flat frequency response of the VDF, which may be different for other AMNs)..... 67

Figure E.5 – Arrangement showing the measurement grounding sheet (shown with dotted lines) when measuring the impedance with reference to RGP. The impedance measurement cable ground is connected to the measurement grounding sheet, whereas the inner conductor is connected to the EUT port pin. 68

Figure E.6 – Impedance measured with the arrangement of Figure E.5 with reference to the RGP. 68

Figure E.7 – VDF measured with parallel resonances in the AMN grounding 69

Figure E.8 – Attenuation of a sheath current absorber measured in a 150-Ω test arrangement 70

Figure E.9 – Arrangement for the measurement of attenuation due to PE chokes and sheath current absorbers..... 70

Table 1 – Minimum scan times for the three CISPR bands with peak and quasi-peak detectors..... 18

Table A.1 56

Table A.2 56

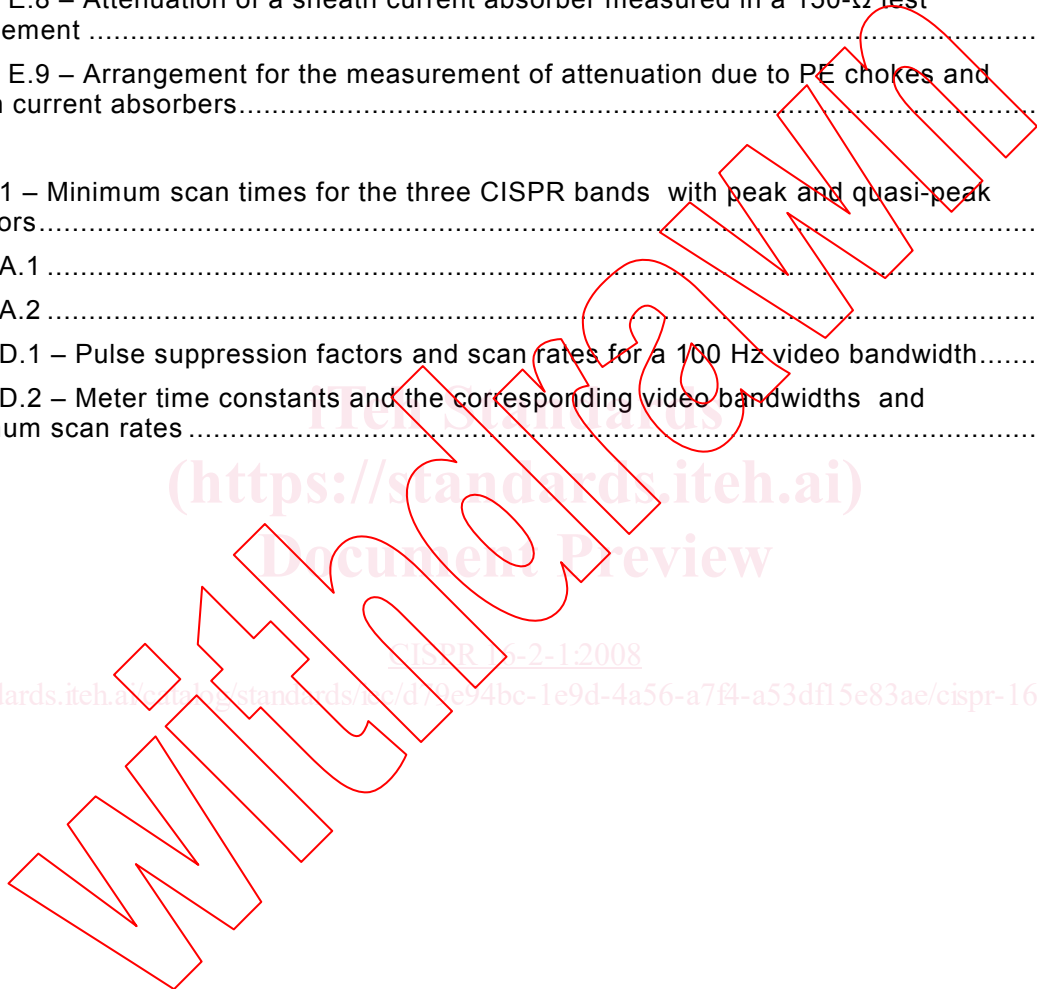
Table D.1 – Pulse suppression factors and scan rates for a 100 Hz video bandwidth..... 63

Table D.2 – Meter time constants and the corresponding video bandwidths and maximum scan rates 64

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INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

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

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

FOREWORD

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

This second edition of CISPR 16-2-1 cancels and replaces the first edition (2003) and its Amendment 1 (2005) and constitutes a technical revision.

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.

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

FDIS	Report on Voting
CISPR/A/798/FDIS	CISPR/A/809/RVD

Full information on the voting for the approval of this 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 this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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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 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, *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 IEC 161-04-36 (modified).

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 IEC 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 IEC 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.

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 IEC 161-03-11, IEC 161-03-12, IEC 161-03-14 and IEC 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

[IEC 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 IEC 161-03-01, IEC 161-03-11 and IEC 161-03-14).

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 1 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

3.28

number of sweeps per time unit (e.g. per second)

 n_s

$1/(\text{sweep time} + \text{retrace time})$

3.29**observation time** T_o

sum of measurement times T_m on a certain frequency in case of multiple sweeps. If n is the number of sweeps or scans, then $T_o = n \times T_m$

3.30**total observation time** T_{tot}

effective time for an overview of the spectrum (either single or multiple sweeps). If c is the number of channels within a scan or sweep, then $T_{tot} = c \times n \times T_m$

4 Types of disturbance to be measured**4.1 General**

This clause describes the classification of different types of disturbance and the detectors appropriate for their measurement.

4.2 Types of disturbance

For physical and psychophysical reasons, dependent on the spectral distribution, measuring receiver bandwidth, the duration, rate of occurrence, and degree of annoyance during the assessment and measurement of radio disturbance, distinction is made between the following types of disturbance:

- a) *narrowband continuous disturbance*, i.e. disturbance on discrete frequencies as, for example, the fundamentals and harmonics generated with the intentional application of RF energy with ISM equipment, constituting a frequency spectrum consisting only of individual spectral lines whose separation is greater than the bandwidth of the measuring receiver so that during the measurement only one line falls into the bandwidth in contrast to b);
- b) *broadband continuous disturbance*, which normally is unintentionally produced by the repeated impulses of, for example, commutator motors, and which have a repetition frequency which is lower than the bandwidth of the measuring receiver so that during the measurement more than one spectral line falls into the bandwidth; and
- c) *broadband discontinuous disturbance* is also generated unintentionally by mechanical or electronic switching procedures, for example by thermostats or programme controls with a repetition rate lower than 1 Hz (click-rate less than 30/min).

The frequency spectra of b) and c) are characterized by having a continuous spectrum in the case of individual (single) impulses and a discontinuous spectrum in case of repeated impulses, both spectra being characterized by having a frequency range which is wider than the bandwidth of the measuring receiver specified in CISPR 16-1-1.

4.3 Detector functions

Depending on the types of disturbance, measurements may be carried out using a measuring receiver with:

- a) an average detector generally used in the measurement of narrowband disturbance and signals, and particularly to discriminate between narrowband and broadband disturbance;
- b) a quasi-peak detector provided for the weighted measurement of broadband disturbance for the assessment of audio annoyance to a radio listener, but also usable for narrowband disturbance;
- c) a peak detector which may be used for either broadband or narrowband disturbance measurement.