CISPR 16-2-1

Edition 2.0 2010-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

AMENDMENT 1
AMENDEMENT 1

**Specification for radio disturbance and immunity measuring apparatus and methods –
Part 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

This amendment has been prepared by subcommittee A: Radio-interference measurements and statistical methods, of IEC technical committee CISPR: International special committee on radio interference in cooperation with CISPR subcommittee D: Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices.

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

CDV	Report on voting
CISPR/A/874/CDV	CISPR/A/897/RVC

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

INTRODUCTION

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.

2 Normative references

Replace the existing reference to CISPR 16-1-1 by the following new reference:

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*

Remove the existing reference to CISPR/TR 16-3 and its Amendments 1 and 2.

Add to the existing list, the title of the following new standard as follows:

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

3 Definitions

Replace the existing term, definition and note 3.7 as follows:

3.7
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.

3.15
measuring receiver

Replace the existing definition and note as follows:

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

Delete the existing note in definition 3.16.

Replace the existing term, definition and Notes 1 and 2 in definition 3.19 by the following new terms, notes and definitions 3.19, 3.19.1, 3.19.2, 3.19.3, 3.19.4 and 3.19.5:

3.19
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

Delete the existing note in definition 3.20.

3.21
discontinuous disturbance

Delete the existing Note 2 in definition 3.21.

Add, after the existing definition 3.30, the following new terms and definitions 3.31, 3.32, 3.33, and 3.34:

3.31
measurement
process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity

[ISO/IEC Guide 99:2007, 2.1]

3.32
test
technical operation that consists of the determination of one or more characteristics of a given product, process or service according to a specified procedure

NOTE A test is carried out to measure or classify a characteristic or a property of an item by applying to the item a set of environmental and operating conditions and/or requirements.

[IEC 60050-151:2001, 151-16-13]

3.33
reference ground
reference potential connecting point

NOTE 1 In some subclauses of this standard the term “ground reference” may be used to denote reference ground.

NOTE 2 There can only be one reference ground in a conducted disturbance measurement system.

3.34
protective earthing
earthing a point or points in a system or in an installation or in equipment, for purposes of electrical safety

[IEC 60050-195:1998, 195-01-11]

4.3 Detector functions

Replace the existing item c) of the list as follows:

c) an rms-average detector provided for the weighted measurement of broadband disturbance for the assessment of the effect of impulsive disturbance to digital radio communication services but also useable for narrowband disturbance;

Add the following new item d) to the existing list:

d) a peak detector which may be used for either broadband or narrowband disturbance measurement.

5.3 Connections to RF reference ground

In the first sentence of this subclause, delete the existing words "or reference wall."

6.1 General

Delete the existing item e).

6.2.1 General

Replace the second sentence of this subclause by the following new sentence:

Should the ambient noise level exceed the required level, it shall be recorded in the test report.

6.5.3 Measurement of the duration of disturbances

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

The duration of a disturbance must be known in order to measure it correctly and to determine if it is discontinuous. The duration of a disturbance may be measured in one of the following ways:

- through the connection of an oscilloscope to a measuring receiver's IF output to allow monitoring of the disturbance in the time-domain;
- through the tuning of either an EMI receiver or a spectrum analyzer to the disturbance frequency without frequency scanning (i.e. 'zero-span' mode) to allow monitoring of the disturbance in the time-domain; or
- through the use of the time-domain output of an FFT-based measuring receiver.

Guidance for the determination of the appropriate measurement time can be found in 8.3.

6.6.2 Minimum measurement times

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

The minimum measurement (dwell) times are given in Table 2. The minimum measurement (dwell) times for scanning receivers and FFT-based measuring instruments in Table 2 and the scan times for spectrum analyzers in Table 1 apply to CW signals. The minimum scan times of Table 1 were derived to perform measurements in the entire CISPR band.

Add, after the existing Table 1, the following new Table 2:

Table 2 – Minimum measurement times for the four CISPR bands

Frequency band		Minimum measurement time T_m
A	9 kHz to 150 kHz	10,00 ms
B	0,15 MHz to 30 MHz	0,50 ms
C and D	30 MHz to 1 000 MHz	0,06 ms
E	1 GHz to 18 GHz	0,01 ms

In the second paragraph of this subclause delete the existing first sentence, "The scan times in Table 1 apply for CW signals."

Add, after the existing Subclause 6.6.5, the following new Subclause 6.6.6:

6.6.6 Timing considerations using FFT-based instruments

FFT-based measuring instruments may combine the parallel calculation at N frequencies and a stepped scan. For this purpose, the frequency range of interest is subdivided into a number of segments N_{seg} that are scanned sequentially. The procedure is shown in Figure 19 for three segments. The total scan time for the frequency range of interest T_{scan} is calculated as:

$$T_{scan} = T_m N_{seg} \quad (4)$$

where

T_m is the measurement time for each segment and

N_{seg} is the number of segments

FFT-based measuring instruments may also provide methods to improve the frequency resolution across a given frequency range. In general, an FFT-based measuring instrument will have a fixed frequency step $f_{step\ FFT}$ that is determined by the number of frequencies of the FFT. Increased frequency resolution is achieved by performing repeat calculations over a given frequency range. For each repeat calculation, the lowest frequency is incremented by a step ratio, $f_{step\ final}$.

Hence the first calculation over the given frequency range considers the following frequencies:

f_{min},
$f_{min} + f_{step\ FFT}$,
$f_{min} + 2f_{step\ FFT}$,
$f_{min} + 3f_{step\ FFT}$…

The second calculation over the given frequency range considers the following frequencies:

$f_{min} + f_{step\ final}$,
$f_{min} + f_{step\ final} + f_{step\ FFT}$,
$f_{min} + f_{step\ final} + 2f_{step\ FFT}$,
$f_{min} + f_{step\ final} + 3f_{step\ FFT}$…

This procedure, applied for a step ratio of 3, is displayed on Figure 20.

The scan time T_{scan} is calculated as:

$$T_{scan} = T_m \frac{f_{step\,FFT}}{f_{step\,final}} \quad (5)$$

where

T_{m} is the measurement time and

$\frac{f_{\mathrm{step\,FFT}}}{f_{\mathrm{step\,final}}}$ is the step ratio.

For a system that combines both methods, the scan time T_{scan} is calculated as:

$$T_{\mathrm{scan}} = T_{\mathrm{m}} N_{\mathrm{seg}} \frac{f_{\mathrm{step\,FFT}}}{f_{\mathrm{step\,final}}} \tag{6}$$

NOTE 1 FFT-based measuring instruments may combine both methods, the stepped scan as well as a method to improve the frequency resolution.

NOTE 2 Additional background information is currently in preparation for CISPR 16-3.[1]

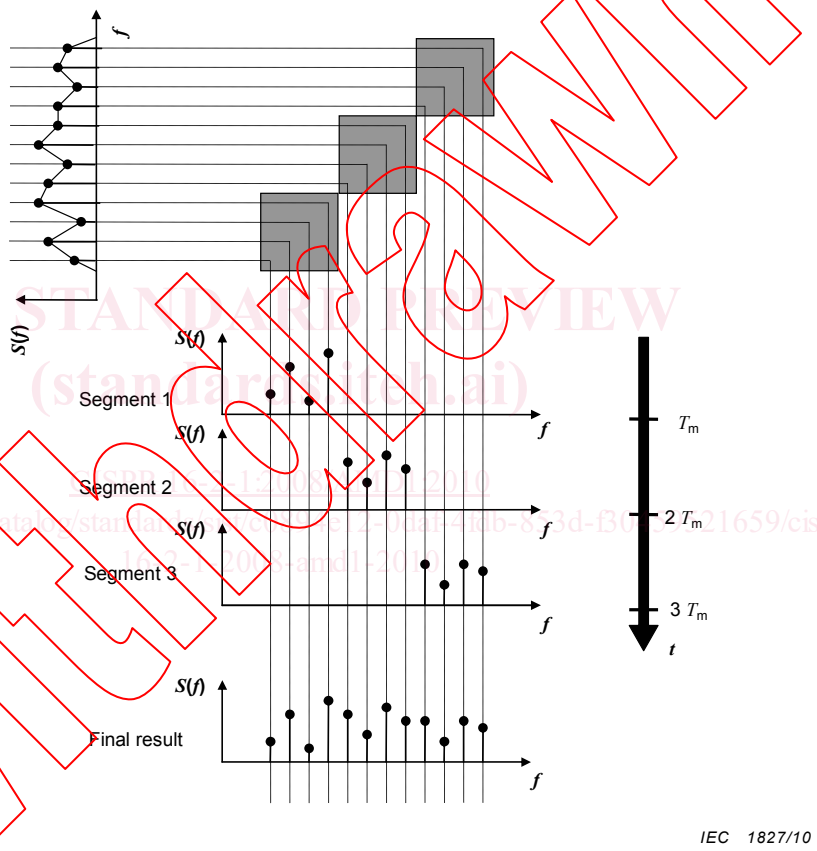

Figure 19 – FFT scan in segments

[1] A CISPR/TR 16-3 is to be published to replace CISPR 16-3:2003 and its amendments.

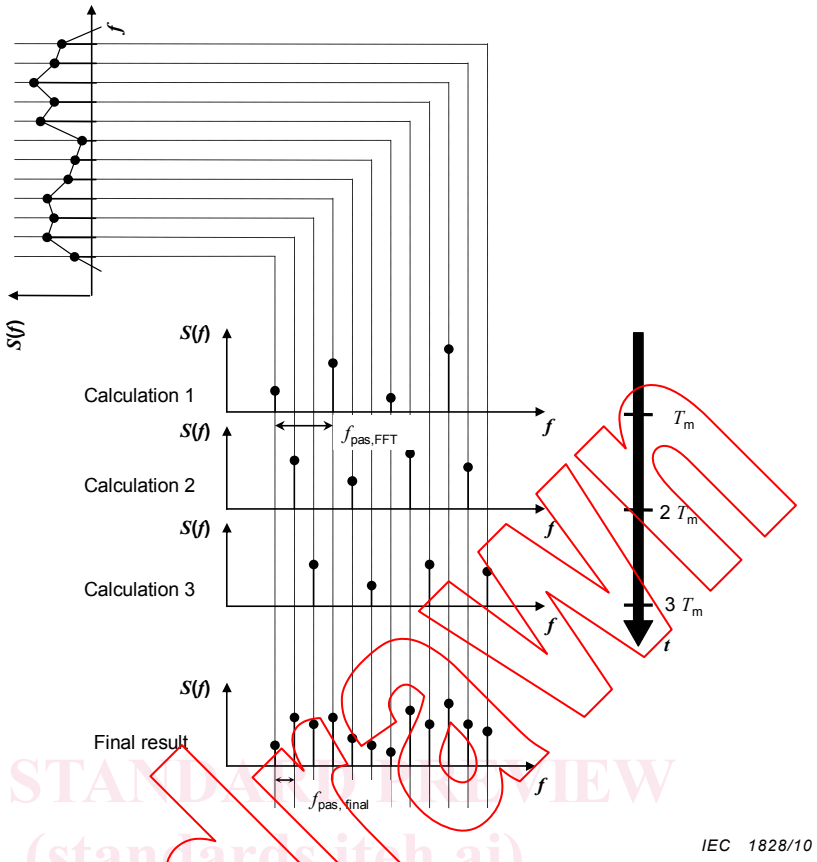

Figure 20 – Frequency resolution enhanced by FFT-based measuring instrument

7.3.4 Current probes

Add the following new paragraph, note and Figure 21 between the existing second and third paragraphs of this subclause:

The current probe cannot be used for the measurement of the converted common mode (CCM) current between an AAN and the EUT. The CCM shall only be measured by the voltage at the output of the AAN [see 7.3.2.2 c)].

NOTE The purpose of the AAN is to simulate the disturbance potential of the network cabling that is attached to the telecommunication port of the EUT. Thus, in response to the differential-mode voltage launched onto the network at the telecommunication port of the EUT, the AAN generates an internal, common-mode voltage that represents the converted common-mode (CCM) voltage that would be generated by the attached network cabling. This internally generated common-mode voltage has an associated common-mode current (I_{CCM} in Figure 21). This current undergoes current division within the AAN (into I_{CCM1} and I_{CCM2} in Figure 21). The current division is determined by the common mode impedance of the AAN output (Z_T on Figure 21) and the common mode impedance presented at the AAN's EUT terminal (Z_E in Figure 21). The common-mode impedance of the AAN output is controlled and hence the common-mode voltage at the AAN output (V_{CCM} in Figure 21) should be the measure of the disturbance potential of the connected network. The common mode impedance presented at the AAN's EUT port is not controlled: rather, it varies with frequency and depends upon the EUT size and the EUT arrangement. Hence this CCM current (I_{CCM2} in Figure 21) cannot be measured with a current probe because, for IT equipment of typical size, the magnitude of Z_E varies from around 2 kΩ to around 200 Ω, in the frequency range from 150 kHz to 30 MHz.

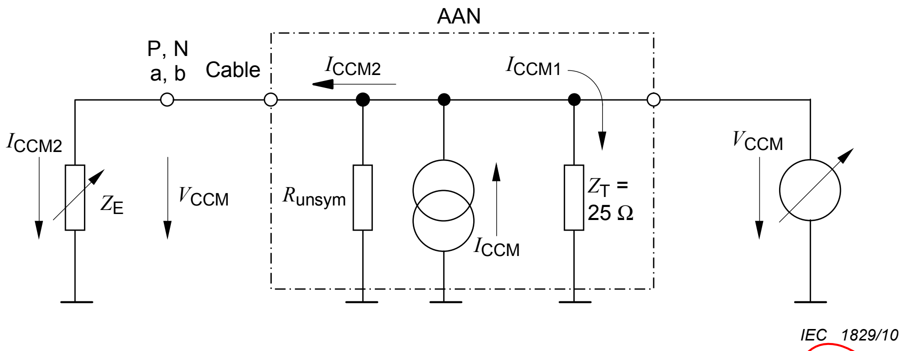

Figure 21 – Illustration of current I_{CCM}

Figure 6 – Test configuration: table-top equipment for conducted disturbance measurements on power mains

In the existing Note 1, replace the last sentence by the following new sentence:

If the bend radius causes the bundle length to exceed 40 cm, the bend radius shall determine the bundle length.

7.4.1 Arrangement of the EUT and its connection to the AN

Throughout this subclause, replace "groundplane" by "ground plane."

In the first dashed item of the second paragraph of this subclause, replace the phrase "a grounded metal plane of" by the new following phrase "a grounded metal sheet with dimensions of."

After the last paragraph of this subclause, delete the existing note.

7.5.1 General approach to system measurements

In the fourth paragraph of this subclause, replace the last sentence by the following:

However, in this latter case, test results with an AMN shall be preferred.

7.5.2.2 Interfacing equipments, simulators and cables

In the first paragraph of this subclause, replace the last sentence by the following:

Therefore, measurements with an actual interfacing unit shall be preferred.

7.6.1 General

In the first bulleted item of this subclause, delete the existing phrase " or the reference mass."

7.6.2 Reference ground

In the first paragraph of this subclause, replace the existing phrase "earth ground" by the new term "earth."

8.5 Emission maximization and final measurement

After the last paragraph of this subclause, add the following new note: