CISPR 16-1-1

Edition 2.0 2007-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

AMENDMENT 2
AMENDEMENT 2

Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus

Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-1: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Appareils de mesure

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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 corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

CISPR 16-1-1

Edition 2.0 2007-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

AMENDMENT 2
AMENDEMENT 2

Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus

Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-1: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Appareils de mesure

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX H

ICS 33.100.10

ISBN 2-8318-9219-8

FOREWORD

This amendment has been prepared by subcommittee A of CISPR: Radio-interference measurements and statistical methods.

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

FDIS	Report on voting
CISPR/A/737/FDIS	CISPR/A/751/RVD

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 amendment and the base 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

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

Page 3

Contents

Replace the title of Clause 7 with the following new title:

7 Measuring receivers with rms-average detector for the frequency range 9 kHz to 18 GHz

Replace the title of Annex A with the following new title:

Annex A (normative) Determination of response to repeated pulses of quasi-peak and rms-average measuring receivers (Subclauses 3.2, 4.4.2, 7.3.2 and 7.5.2)

Add to the list of tables the titles of the new tables as follows:

Table 15 – VSWR requirements of input impedance

Table 16 – Bandwidth requirements

Table 17 – Minimum pulse repetition rate without overload

Table 18 – Relative pulse response of rms-average and quasi-peak measuring receivers

Table 19 – Pulse response of rms-average receiver

Table 20 – Maximum reading of rms-average measuring receivers for a pulse-modulated sine-wave input in comparison with the response to a continuous sine-wave having the same amplitude

Page 11

1 Scope

Replace, in existing item d), “r.m.s. measuring receiver” by “rms-average measuring receiver”.

Page 13

3 Terms and definitions

Add the following new definitions:

3.10
weighting (of e.g. impulsive disturbance)
the 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

– 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).
– 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.

3.10.1
weighting characteristic
the 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

3.10.2
weighting function or weighting curve
the 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

3.10.3
weighting factor
the value in dB of the weighting function relative to a reference PRF or relative to the peak value

3.10.4
weighting detector
detector which provides an agreed weighting function

3.10.5
weighted disturbance measurement
measurement of disturbance using a weighting detector

Page 55

7 Measuring receivers with rms detector for the frequency range 9 kHz to 18 GHz

Replace the existing title and text of Clause 7 with the following:

7 Measuring receivers with rms-average detector for the frequency range 9 kHz to 18 GHz

7.1 General

RMS-average weighting receivers employ a weighting detector that is a combination of the rms detector (for pulse repetition frequencies above a corner frequency f_c) and the average detector (for pulse repetition frequencies below the corner frequency f_c), thus achieving a pulse response curve with the following characteristics: 10 dB/decade above the corner frequency and 20 dB/decade below the corner frequency.

Spectrum analyzers that meet the requirements of this clause can be used for compliance measurements.

7.2 Input impedance

The input circuit of measuring receivers shall be unbalanced. For receiver control settings within the CISPR indicating range, the input impedance shall be nominally 50 Ω with a VSWR not to exceed the values in Table 15.

Table 15 – VSWR requirements of input impedance

Frequency range	RF attenuation dB	VSWR
9 kHz to 1 GHz	0	2,0 to 1
9 kHz to 1 GHz	10	1,2 to 1
1 GHz to 18 GHz	0	3,0 to 1
1 GHz to 18 GHz	10	2,0 to 1

Symmetric input impedance in the frequency range 9 kHz to 30 MHz: to permit symmetrical measurements, a balanced input transformer is used. The preferred input impedance for the frequency range 9 kHz to 150 kHz is 600 Ω. This symmetric input impedance may be incorporated either in the relevant symmetrical artificial network necessary to couple to the receiver or optionally in the measuring receiver.

7.3 Fundamental characteristics

7.3.1 Bandwidth

The bandwidths shall lie within the values of Table 16.

Table 16 – Bandwidth requirements

Frequency range	Bandwidth
9 kHz to 150 kHz (band A)	200 Hz (B_6)
150 kHz to 30 MHz (band B)	9 kHz (B_6)
30 MHz to 1 000 MHz (bands C and D)	120 kHz (B_6)
1 GHz to 18 GHz (band E)	1 MHz (B_{imp})
NOTE The chosen value in band E is defined as the impulse bandwidth of the measuring receiver with a tolerance of ± 10 %.	

7.3.2 Overload factor

Above the corner frequency f_c, specified below, the overload factor for circuits preceding the detector at a pulse repetition rate of n Hz shall be $1{,}27(B_3/n)^{1/2}$, with B_3 in Hz. Below the corner frequency the overload factor at a pulse repetition rate of n Hz shall be above the value $1{,}27(B_3/f_c)^{1/2}(f_c/n)$.

NOTE 1 "Corner frequency" is the pulse repetition frequency above which the rms-average detector behaves like an rms detector and below which the rms-average detector has the slope of a linear average detector.

The minimum pulse repetition rate without overload shall conform to the values given in Table 17.

Table 17 – Minimum pulse repetition rate without overload

Frequency range of measuring receiver	Corner frequency f_c kHz	Minimum pulse repetition rate Hz	Ratio peak/rms -average indications dB
9 kHz to 150 kHz (band A)	0,01	5	19
0,15 MHz to 30 MHz (band B)	0,01	5	35,5
30 MHz to 1 000 MHz (bands C and D)	0,1	31,6	40,6
1 GHz to 18 GHz (band E)	1	316	40

NOTE 2 With this type of detector it will not, in general, be possible to provide sufficient overload factor to prevent non-linear operation of the instrument at very low pulse repetition rates for short pulses in bands C/D and E (the response to a short single pulse is only theoretically defined in these bands).

NOTE 3 Annex A describes the calculation for the overload factor for the rms detector. Annex B describes the determination of the pulse generator spectrum. Annex C describes the accurate measurement of the output levels of nanosecond pulse generators.

NOTE 4 For band E, the test may be made with a pulse-modulated sine-wave signal, with an occupied bandwidth of e.g. 2 MHz. Clause E.6 gives the specification of an applicable test signal.

7.4 Sine-wave voltage accuracy

The accuracy of measurement of sine-wave voltages shall be better than ± 2 dB (± 2,5 dB above 1 GHz) when supplied with a sine-wave signal at 50 Ω resistive source impedance.

7.5 Response to pulses

7.5.1 Construction details

The detector function can be represented by an rms detector that continuously determines rms values during periods of time equal to the reciprocal of the corner frequency f_c. These rms values are then passed through a second order low-pass filter that corresponds to the critically damped indication that is specified for the quasi-peak detector, the time constant of which is defined up to 1 GHz. For band E, the time constant is 100 ms. In case of variation with time, the maximum output of the low-pass filter is the measurement result.

NOTE Annexes B, C and E (currently included in CISPR 16-1-1) describe methods for determining the output characteristics of pulse generators for use in testing the requirements of this clause.

7.5.2 Amplitude relationship

The response of the measuring receiver for band A to pulses of impulse area [$278\ (B_3)^{-1/2}$] μVs emf. at a 50 Ω source impedance which have a uniform spectrum up to at least the highest tuneable frequency of band A, and repeated at a frequency of 25 Hz, shall for all frequencies of tuning, be equal to the response to an unmodulated sine-wave signal at the tuned frequency having an emf of 2 mV (66 dB(μV)) rms. For the measuring receivers for bands B, C, D and E, the corresponding values are [$44\ (B_3^{-1/2})$] μVs and 1 000 Hz. The source impedances of the pulse generator and the signal generator shall both be the same. A tolerance of ±1,5 dB is permitted in the sine-wave voltage levels prescribed above.

NOTE Annex A describes the calculation for the pulse response of the rms detector. At a repetition frequency of 25 Hz and 100 Hz (i.e. the quasi-peak detector reference pulse repetition frequency), respectively, the relationship between the indications of an rms-average and a quasi-peak measuring receiver of the same bandwidth is given in Table 18.

Table 18 – Relative pulse response of rms-average and quasi-peak measuring receivers

Frequency range of measuring receiver	Pulse repetition rate Hz	Ratio quasi-peak/rms -average indications dB
9 kHz to 150 kHz (band A)	25	4,2
0,15 MHz to 30 MHz (band B)	100	14,3
30 MHz to 1 000 MHz (bands C and D)	100	20,1

7.5.3 Variation with repetition frequency

The response of the measuring receiver to repeated pulses shall be such that, for a constant indication on the measuring receiver, the relationship between amplitude and repetition frequency above the corner frequency f_c shall be in accordance with the following rule:

– amplitude proportional to (repetition frequency)$^{-1/2}$.

Below the corner frequency f_c the relationship shall be in accordance with the following rule:

– amplitude proportional to (repetition frequency)$^{-1}$.

The response curve for a particular receiver shall lie between the limits in Table 19.

Table 19 – Pulse response of rms-average receiver

Repetition frequency Hz	Relative equivalent level of pulse in dB			
	Band A	Band B	Bands C and D	Band E
100 000	–	–	(–20 ± 2,0)	–20 ± 2,0
10 000	–	–	–10 ± 1,0	–10 ± 1,0
1 000	–	0 (ref.)	0 (ref.)	0 (ref.)
316	–	+5 ± 0,5	+5 ± 0,5	+10 ± 1,0
100	–6 ± 0,6	+10 ± 1,0	+10 ± 1,0	(+20 ± 2,0)
31,6	–	+15 ± 1,5	+20 ± 2,0	
25	0 (ref.)	+16 ± 1,6		
10	+4 ± 0,4	+20 ± 2,0		
5	+9 ± 0,7	+25 ± 2,3		
1	–	–		

NOTE 1 Values in brackets are for information only.

NOTE 2 The values at 5 Hz for bands A and B take into account the effect of the meter time constant.

7.5.4 Response to intermittent, unsteady and drifting narrowband disturbances

The response to intermittent, unsteady and drifting narrowband disturbances shall be such that the measurement result is equivalent to the peak reading of a meter with a time constant of 160 ms for bands A and B and of 100 ms for bands C, D and E. This can be accomplished by the meter simulating network (analog or digital) to which the rms values described in 7.5.1 are used as input.

It is deduced from the above requirement that an rms-average measuring receiver shall yield the maximum reading listed in Table 9 for a radiofrequency sine-wave input signal modulated with repeated rectangular pulses having the duration and period indicated in Table 20. A tolerance of ± 1,0 dB is allowed for this requirement.

Table 20 – Maximum reading of rms-average measuring receivers for a pulse-modulated sine-wave input in comparison with the response to a continuous sine-wave having the same amplitude

Repeated rectangular pulses for modulation	Band A/B receiver T_M = 0,16 s	Band C/D/E receiver T_M = 0,1 s
Duration = T_M Period = 1,6 s	0,398 (= –7,9 dB)	0,353 (= –9,0 dB)
NOTE The value for the band A/B receiver can vary by about ± 0,5 dB due to varying overlapping of the 160 ms pulse duration with the 100 ms rms integration time duration.		

7.6 Selectivity

The selectivity curves for the rms-average weighting receiver shall be equal to those of Figures 2a, 2b and 2c, for bands A, B, C and D. For the band E receiver, the selectivity curve is given in Figure 8.

The requirements of 4.5.2, 4.5.3 and 4.5.4 apply. For band E receivers, requirements are under consideration.

7.7 Intermodulation effects, receiver noise, and screening

For the frequency range below 1 GHz, the requirements of 4.6, 4.7 and 4.8 apply. Subclauses 4.7 as well as 4.8.1 also apply for band E.

For band E, the following applies.

– Requirements for intermodulation effects are under consideration.

– Preselection filter for band E: When measuring weak spurious signals in the presence of a strong fundamental signal from certain equipment under test, a filter shall be provided at the input of the measuring receiver to ensure adequate attenuation at the fundamental frequency to protect the input circuits of the receiver from overload and damage, and to prevent the generation of harmonic and intermodulation signals.

NOTE 1 30 dB filter attenuation at the fundamental frequency of the equipment under test is normally adequate.

NOTE 2 A number of such filters may be required to deal with more than one fundamental frequency.

Requirements for screening effectiveness, i.e. the immunity to high ambient radiated disturbances, are under consideration.

Page 81

Annex A

Replace the existing title of the annex by the following:

Determination of response to repeated pulses of quasi-peak and rms-average measuring receivers (Subclauses 3.2, 4.4.2, 7.3.2 and 7.5.2)

A.1 General

Add the following note after the text of this clause.

NOTE The text on the rms detector in this annex deals with the rms measuring receiver in theory and applies to the rms-average measuring receiver above the corner frequency f_c as defined in Clause 7.

_____