TECHNICAL REPORT

CISPR 16-4-4

Second edition
2007-07

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

Specification for radio disturbance and immunity measuring apparatus and methods –

Part 4-4: Uncertainties, statistics and limit modelling – Statistics of complaints and a model for the calculation of limits for the protection of radio services

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INTERNATIONAL ELECTROTECHNICAL COMMISSION
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FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

This second edition of CISPR 16-4-4, which is a technical report, has been prepared by CISPR subcommittee H: Limits for the protection of radio services.

This second edition of CISPR 16-4-4 contains two thoroughly updated Clauses 4 and 5, compared with its first edition. It also contains, in its new Annex A, values of the classical CISPR mains decoupling factor which were determined by measurements in real LV AC mains grids in the 1960s. It is deemed that these mains decoupling factors are still valid and representative also for modern and well maintained LV AC mains grids around the world.

The information in Clause 4 – Statistics of complaints and sources of interference – was accomplished by the history and evolution of the CISPR statistics on complaints about radio frequency interference (RFI) and by background information on evolution in radio-based communication technologies. Furthermore, the forms for collation of actual RFI cases were detailed and structured in a way allowing for more qualified assessment and evaluation of compiled annual data in regard to the interference situation, as e.g. fixed or mobile radio reception, or analogue or digital modulation of the interfered with radio service or application concerned.

The information in Clause 5 – A model for the calculation of limits – was accomplished in several ways. The model itself was accomplished in respect of the remote coupling situation as well as the close coupling one. Further supplements of this model were incorporated regarding certain aspects of the coupling path via induction and wave propagation (radiation) of classical telecommunication networks. Furthermore, the calculation model on statistics and probability underwent revision and was brought in line with a more modern mathematical approach. Eventually the present model was extended for a possible determination of CISPR limits in the frequency range above 1 GHz.

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

Enquiry draft	Report on voting
CISPR/H/147/DTR	CISPR/H/153/RVC

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.

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

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

A bilingual version of this publication may be issued at a later date.

SPECIFICATION FOR RADIO DISTURBANCE AND IMMUNITY MEASURING APPARATUS AND METHODS –

Part 4-4: Uncertainties, statistics and limit modelling – Statistics of complaints and a model for the calculation of limits for the protection of radio services

1 Scope

This part of CISPR 16 contains a recommendation on how to deal with statistics of radio interference complaints. Furthermore it describes the calculation of limits for disturbance field strength and voltage for the measurement on a test site based on models for the distribution of disturbances by radiated and conducted coupling, respectively.

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), *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

CISPR 11, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 16-4-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-3: Uncertainties, statistics and limit modelling – Statistical considerations in the determination of EMC compliance of mass-produced products*

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 60050(161) as well as the following apply.

3.1
complaint
a request for assistance made to the RFI investigation service by the user of a radio receiving equipment who complains that reception is degraded by radio frequency interference (RFI)

3.2
RFI investigation service
institution having the task of investigating reported cases of radio frequency interference and which operates at the national basis

NOTE Examples include a radio service provider, a CATV network provider, an administration, or a regulatory authority.

3.3
source
any type of electric or electronic equipment, system, or (part of) installation emanating disturbances in the radio frequency (RF) range which can cause radio frequency interference to a certain kind of radio receiving equipment

4 Statistics of complaints and sources of interference

4.1 Introduction and history

The previous edition of CISPR 16-4-4 contained, in its Clause 4, a complete reprint of CISPR Recommendation 2/3 on statistics of complaints and sources of interference. However, due to modern technological evolution in radio systems directed towards introduction of digital radio services, and due to increasing use of mobile and portable radio appliances by the public, the traditional CISPR statistics of complaints on radio frequency interference are experiencing a decreasing significance as an indicator of the quality of standardisation work for the protection of radio services and applications. That is why related information in this edition of CISPR 16-4-4 is reduced to the necessary minimum allowing interested parties to continue their complaint-based collation of data on an annual basis.

In order to accommodate the evolution in modern radio technology and mobile and portable use of radio receiving equipment, it may be necessary to replace or to gather the complaints-based CISPR statistics by other more modern statistics or means. These new statistics should be based on a systematic annual collation of data about degradation of quality of radio services and reception due to electromagnetic disturbances occurring in the environment. These data will have to be collected and processed, however, primarily by the radio service providers themselves.

4.2 Relationship between radio frequency interference and complaints

Whatever the radio system involved, official complaints usually represent only a small subset of all occurring interference situations. Occasional interference generally does not lead to an official complaint if its duration is brief or if it happens only once in a while. It is only when the same interference situation occurs repetitively that an official complaint is reported. This situation also greatly depends on the conditions of use (fixed or mobile) of the victim radio system.

4.2.1 Radio frequency interference to a fixed radio receiver

Before the wide development of portable radio devices, radio systems that suffered from interference were generally used in fixed locations. This is the case, for example for a TV set in a flat or home: if this TV set is regularly interfered with by radiation or conduction from other equipment located inside or just outside the house, then it is probable that a complaint will be issued. The same applies if a satellite antenna, a fixed radio link, or a cellular phone base station suffers from radio frequency interference.

4.2.2 Radio frequency interference to a mobile radio receiver

The multiplication of portable radio systems such as cellular phones and short range radio systems has changed the conditions regarding interference situations and interference complaints. The ability for the user to move makes it easier to resolve a particular interference case, but makes it more difficult to recognise that an interference case has actually occurred.

4.2.3 Consequences of the move from analogue to digital radio systems

In addition to the conditions of use of the victim radio system, technological evolution in radio services with successive phasing out of analogue and exponential growth of digital applications also has consequences on the number of reported interference cases.

If a digital mobile phone or a wireless LAN receiver cannot receive the signal from the nearest base station or access point because of an unwanted emission from a nearby equipment, the user will never suspect this equipment and will not even consider the possibility of an interference occurring. He will assume that the coverage of the network is poor and will move to another place to make his call or to get his connection. Furthermore, as these systems are generally frequency agile, if one channel is interfered with, the system will choose another channel, but if all other channels are occupied, then the phone will indicate that the network is

busy, and once again, the user will think the network capacity is not large enough to accommodate his call, but he will never suspect an EMC problem.

Generally for analogue systems, one can hear the interference. With digital and mobile systems, interference is much less noticeable (muting in audio reception, or frozen images on the TV set for DVB). In addition, modern digital modulations implement complex escape mechanisms (data error correction, frequency agile systems, etc.) so that the system can already be permanently affected from an EMC point of view before an interference case is actually detected.

4.3 Towards the loss of a precious indicator: interference complaints

The evolutions detailed above – generalisation of mobile use of radio receivers and the move from analogue to digital radio services – will not reduce the number of interference situations, but continues to decrease the probability of getting significant numbers of interference complaints indicating an existing EMC problem. So, along with the growing development of portable digital radio devices, the usefulness of traditional interference complaints statistics to support the CISPR work will continue to diminish in importance.

4.4 CISPR recommendations for collation of statistical data on interference complaints and classification of interference sources

Considering

a) that RFI investigation services may whish to continue publication of statistics on interference complaints;

b) that it would be useful to be able to compare the figures for certain categories of sources;

c) that varied and ambiguous presentation of these statistics often renders this comparison difficult,

CISPR recommends

(1) that the statistics provided to National Committees should be in such a form that the following information may be readily extracted:

(1.1) the number of complaints as a percentage of the total number of sound broadcast receivers or television broadcast receivers or other radio communication receivers in operation in a certain country, or region;

(1.2) the relative aggressivity of the various sources of interference in the different frequency bands;

(1.3) the comparison of the interference caused by the same source in different frequency bands;

(1.4) the effectiveness of limits (CISPR or national) and other counter-measures on items (1.1), (1.2), and (1.3);

(1.5) the number of sources of the same type involved in a certain interference case. Interference may be caused by a group of devices, for example, a number of fluorescent lamps on one circuit. In such cases, the number to be entered into the statistics is determined by the RFI investigation service.

NOTE To facilitate comparison of statistics, the method used to determine the number of sources should be stated.

One source may cause many complaints and one complaint may be caused by more than one source. Therefore it is clear that the number of sources and the number of complaints against any classification code may not be related.

For the purpose of these statistics, active generators of electrical energy and apparatus and installations which cause interference by secondary effects (secondary modulation) are included. See also appliances of category B in Table 1;

(1.6) causes of complaints not related to a source, as e.g. unsatisfactory radio reception due to a lack of immunity of the radio receiving installation or a lack of coverage with wanted radio signals, see also appliances of category K in Table 1;

(2) that statistics should cover a complete calendar year; they should whenever possible be presented in the following form, see standard forms in Figures 1a to 1d, without necessarily employing more detailed categories than listed in Table 1. It is however not intended to exclude further subdivisions; these may be desirable, but they should fit into the scheme of the standard forms set out below; the code numbers refer to the items listed in Table 1.

4.5 Forms for statistics of interference complaints

1	**Radio services with analogue modulation**										
1.1	**Fixed or stationary radio reception**										
Source of interference or other cause of complaint					**Number of complaints per radio service from each source**						
Classification code			**Description**	**Total number in each identification**	**Broadcasting** [a]					**Other services** [b]
					Sound [c]		**Television** [c]			
					LF/ MF/ HF	**II**	**I**	**III**	**IV/V**	
A	1	1								
	2	1								
			etc. as indicated in Table 1							
1.1	Fixed or stationary radio reception, analogue modulation			Totals						

a LF = low radio frequency (long waves);
MF = medium radio frequency (medium waves);
HF = high radio frequency (short waves).
These three bands may either be grouped together, as shown, or dealt with separately.
II = Band II (VHF/sound broadcasting);
I = Band I (VHF/television broadcasting);
III = Band III (VHF/television broadcasting);
IV/V = Band IV/V (UHF/television broadcasting).

b The service and band affected should be stated.

c At the time of receipt of complaints of interference, i.e. before they have been investigated fully, it may not be possible to apportion the complaints accurately to the various broadcasting services. If this is so, then the number of complaints should be stated separately for sound broadcasting and television broadcasting.

IEC 1182/07

Figure 1a – Standard form for statistics on interference complaints recommended for radio services with analogue modulation and fixed or stationary radio reception

<table>
<tr><th colspan="2">1</th><th colspan="9">Radio services with analogue modulation</th></tr>
<tr><th colspan="2">1.2</th><th colspan="9">Mobile or portable radio reception</th></tr>
<tr><th colspan="5">Source of interference
or other cause of complaint</th><th colspan="6">Number of complaints per radio service
from each source</th></tr>
<tr><th colspan="3" rowspan="3">Classification code</th><th rowspan="3">Description</th><th rowspan="3">Total number in each identification</th><th colspan="5">Broadcasting [a]</th><th>Other services [b]</th></tr>
<tr><th colspan="2">Sound [c]</th><th colspan="3">Television [c]</th><th></th></tr>
<tr><th>LF/ MF/ HF</th><th>II</th><th>I</th><th>III</th><th>IV/V</th><th></th></tr>
<tr><td>A</td><td>1
2</td><td>1
1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">etc. as indicated in Table 1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1.2</td><td colspan="3">Mobile or portable radio reception, analogue modulation</td><td>Totals</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

a LF = low radio frequency (long waves);
MF = medium radio frequency (medium waves);
HF = high radio frequency (short waves).
These three bands may either be grouped together, as shown, or dealt with separately.
II = Band II (VHF/sound broadcasting);
I = Band I (VHF/television broadcasting);
III = Band III (VHF/television broadcasting);
IV/V = Band IV/V (UHF/television broadcasting).

b The service and band affected should be stated.

c At the time of receipt of complaints of interference, i.e. before they have been investigated fully, it may not be possible to apportion the complaints accurately to the various broadcasting services. If this is so, then the number of complaints should be stated separately for sound broadcasting and television broadcasting.

Figure 1b – Standard form for statistics on interference complaints recommended for radio services with analogue modulation and mobile or portable radio reception

2	Radio services with digital modulation										
2.1	Fixed or stationary radio reception										
Source of interference or other cause of complaint					Number of complaints per radio service from each source						
Classification code			Description	Total number in each identification	Broadcasting [a]					Other services [b]
					Sound [c]		Television [c]			
					LF/ MF/ HF	II	I	III	IV/V	
A	1	1								
	2	1								
		etc. as indicated in Table 1								
2.1	Fixed or stationary radio reception, digital modulation			Totals						

a LF = low radio frequency (long waves);

MF = medium radio frequency (medium waves);

HF = high radio frequency (short waves).

These three bands may either be grouped together, as shown, or dealt with separately.

II = Band II (VHF/sound broadcasting);

I = Band I (VHF/television broadcasting);

III = Band III (VHF/television broadcasting);

IV/V = Band IV/V (UHF/television broadcasting).

b The service and band affected should be stated.

c At the time of receipt of complaints of interference, i.e. before they have been investigated fully, it may not be possible to apportion the complaints accurately to the various broadcasting services. If this is so, then the number of complaints should be stated separately for sound broadcasting and television broadcasting.

IEC 1184/07

Figure 1c – Standard form for statistics on interference complaints recommended for radio services with digital modulation and fixed or stationary radio reception

2	**Radio services with digital modulation**										
2.2	**Mobile or portable radio reception**										
Source of interference or other cause of complaint					**Number of complaints per radio service from each source**						
Classification code			**Description**	**Total number in each identification**	**Broadcasting** [a]					**Other services** [b]
					Sound [c]		**Television** [c]			
					LF/ MF/ HF	**II**	**I**	**III**	**IV/V**	
A	1	1								
	2	1								
		etc. as indicated in Table 1								
2.2	Mobile or portable radio reception, digital modulation			Totals						

a LF = low radio frequency (long waves);
MF = medium radio frequency (medium waves);
HF = high radio frequency (short waves).
These three bands may either be grouped together, as shown, or dealt with separately.
II = Band II (VHF/sound broadcasting);
I = Band I (VHF/television broadcasting);
III = Band III (VHF/television broadcasting);
IV/V = Band IV/V (UHF/television broadcasting).

b The service and band affected should be stated.

c At the time of receipt of complaints of interference, i.e. before they have been investigated fully, it may not be possible to apportion the complaints accurately to the various broadcasting services. If this is so, then the number of complaints should be stated separately for sound broadcasting and television broadcasting.

IEC 1185/07

Figure 1d – Standard form for statistics on interference complaints recommended for radio services with digital modulation and mobile or portable radio reception

Figure 1 – Standard forms for statistics on interference complaints

For RFI investigation services which would like to issue reports on statistics of interference complaints it is recommended to use the classification of interference sources set out in Table 1. Use of this classification will facilitate comparison of RFI situations observed in different countries.

Table 1 – Classification of sources of radio frequency interference and other causes of complaint

Classification code	Description of the source
A	**Industrial, scientific, and medical (ISM) RF apparatus (CISPR 11)**
A.1	Industrial, scientific, and medical (ISM) RF apparatus (group 2) inclusive microwave ovens and RF lighting appliances
A.2	Other industrial or similar apparatus (group 2) as e.g. arc welding equipment or spark generating apparatus (EDM), etc.
A.3	Other industrial or similar apparatus (group 1) as e.g. generators, motors, convertors, semiconductor controlled devices, etc.
B	**Electric power supply, distribution and electric traction (CISPR 11, CISPR 18)**
B.1	Power supply installations (AC or DC voltages exceeding 100 kV) as e.g. overhead power lines, generating and switching stations, converting stations, etc.
B.2	Power supply installations (AC or DC voltages 1 kV to 100 kV) as e.g. overhead power lines, generating and switching stations, converting stations, etc.
B.3	Low voltage (LV) power supply and distribution (AC or DC voltages up to 1 kV)
B.4	Electric traction as e.g. for railways, tramways, or trolley buses
C	**Low power appliances as normally used in households, offices and small workshops (CISPR 14)**
C.1	Motors in household appliances e.g. in electric tools, vacuum cleaners, etc.
C.2	Contact devices, thermostats, etc.
C.3	Semiconductor controlled appliances (less than 1 kW load)
D	**Gaseous discharge and other lamps and luminaries (CISPR 15)**
	Fluorescent lamps and luminaries, neon advertising signs, self-ballasted lamps, etc.
E [a]	**Radio broadcast receiving installations (CISPR 13, CISPR 25)**
E.1	Sound broadcast receivers for fixed or mobile use
E.2	Television broadcast receivers for fixed or mobile use
E.3	Cable television installations (CATV)
F [a]	**Radio communication systems (ITU Recommendations)**
F.1	Radio broadcast or communication transmitters for fixed or mobile use
F.2	Radio communication receivers for fixed or mobile use
G	**Ignition systems of internal combustion engines (CISPR 12)**
	Cars, motor bikes, boats, trucks, etc. if propelled by electrical means or internal combustion engines or both, exclusive electric traction vehicles
H	**Information and communication technology (ICT) appliances (CISPR 22)**
H.1	Wire-bound telecommunication terminal equipment (TTE) and telecommunication equipment (TE) in the infrastructure of networks as e.g. in telecommunication centres, wire-bound LAN, etc.
H.2	Data processing equipment (DPE) such as e.g. computers and ancillary equipment
H.3	Radiation from wire-bound telecommunication networks
I	**Identified sources other than those specified (IEC 61000-6-3 and IEC 61000-6-4)**
K	**Other causes of complaint**
K.1	Lack of immunity of radio receiving installations or other appliances
K.2	Lack of coverage of wanted radio service (weak or faulty wanted signals)

[a] Only those complaints belong to the statistics where a radio broadcast receiving installation (E) or a component of a radio communication system (F) was identified as causing the interference.