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# norm

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Specification for radio disturbance and immunity measuring apparatus and methods:Part 4-1: Uncertainties, statistics and limit modelling - Uncertainties in standardized EMC tests (CISPR 16-4-1:2003,IDT)

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- CISPR 16-4-1:2003,IDT

Nederlands Elektrotechnisch Comité (NEC)
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# TECHNICAL REPORT

# CISPR 16-4-1

First edition
2003-11



INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

## Specification for radio disturbance and immunity measuring apparatus and methods –

## Part 4-1: Uncertainties, statistics and limit modelling – Uncertainties in standardized EMC tests

Reference number
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## Specification for radio disturbance and immunity measuring apparatus and methods –

## Part 4-1: Uncertainties, statistics and limit modelling – Uncertainties in standardized EMC tests



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# CONTENTS

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

## Part 4-1: Uncertainties, statistics and limit modelling – Uncertainties in standardized EMC tests

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CISPR 16-4-1, which is a technical report, has been prepared by CISPR subcommittee A: Radio interference measurements and statistical methods

This first edition of CISPR 16-4-1, together with CISPR 16-4-3, CISPR 16-4-4 and the second edition of CISPR 16-3, cancels and replaces the first edition of CISPR 16-3, published in 2000, and its amendment 1 (2002) It contains the relevant clauses of CISPR 16-3 without technical changes

The text of this technical report is based on the first edition of CISPR 16-3 and on the following documents.

| Enquiry draft | Report on voting |
|---|---|
| CISPR/A/450/DTR | CISPR/A/466/RVC |

Full information on the voting for the approval of this technical report 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 bilingual version of this publication may be issued at a later date

The committee has decided that the contents of this publication will remain unchanged until 2004 At this date, the publication will be

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- withdrawn,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

# INTRODUCTION

CISPR 16-1, CISPR 16-2, CISPR 16-3 and CISPR 16-4 have been reorganised into 14 parts, to accommodate growth and easier maintenance The new parts have also been renumbered See the list given below.

| Old CISPR 16 publications | | New CISPR 16 publications | |
|---|---|---|---|
| CISPR 16-1 | Radio disturbance and immunity measuring apparatus | CISPR 16-1-1 | Measuring apparatus |
| | | CISPR 16-1-2 | Ancillary equipment – Conducted disturbances |
| | | CISPR 16-1-3 | Ancillary equipment – Disturbance power |
| | | CISPR 16-1-4 | Ancillary equipment – Radiated disturbances |
| | | CISPR 16-1-5 | Antenna calibration test sites for 30 MHz to 1 000 MHz |
| CISPR 16-2 | Methods of measurement of disturbances and immunity | CISPR 16-2-1 | Conducted disturbance measurements |
| | | CISPR 16-2-2 | Measurement of disturbance power |
| | | CISPR 16-2-3 | Radiated disturbance measurements |
| | | CISPR 16-2-4 | Immunity measurements |
| CISPR 16-3 | Reports and recommendations of CISPR | CISPR 16-3 | CISPR technical reports |
| | | CISPR 16-4-1 | Uncertainties in standardised EMC tests |
| CISPR 16-4 | Uncertainty in EMC measurements | CISPR 16-4-2 | Measurement instrumentation uncertainty |
| | | CISPR 16-4-3 | Statistical considerations in the determination of EMC compliance of mass-produced products |
| | | CISPR 16-4-4 | Statistics of complaints and a model for the calculation of limits |

More specific information on the relation between the 'old' CISPR 16-3 and the present 'new' CISPR 16-4-1 is given in the table after this introduction (TABLE RECAPITULATING CROSS REFERENCES)

Measurement instrumentation specifications are given in five new parts of CISPR 16-1, while the methods of measurement are covered now in four new parts of CISPR 16-2 Various reports with further information and background on CISPR and radio disturbances in general are given in CISPR 16-3. CISPR 16-4 contains information related to uncertainties, statistics and limit modelling.

CISPR 16-4 consists of the following parts, under the general title *Specification for radio disturbance and immunity measuring apparatus and methods - Uncertainties, statistics and limit modelling:*

- Part 4-1. Uncertainties in standardised EMC tests,
- Part 4-2: Uncertainty in EMC measurements,
- Part 4-3 Statistical considerations in the determination of EMC compliance of mass-produced products,
- Part 4-4. Statistics of complaints and a model for the calculation of limits.

For practical reasons, standardised EMC tests are drastic simplifications of all possible EMI scenarios that a product may encounter in practice Consequently, in an EMC standard the measurand, the limit, measurement instruments, set-up, measurement procedure and measurement conditions shall be simplified but still meaningful Meaningful means that there is a statistical correlation between compliance of the product with a standardized EMC test and a high probability of actual EMC of the same product during its life cycle Part 4-4 provides statistical based methods to derive meaningful disturbance limits to protect the radio services

In general, a standardized EMC test must be developed such that reproducible results are obtained if different parties perform the same test with the same product. However, various uncertainty sources and influence quantities cause that the reproducibility of a standardized EMC test is limited Part 4-1 consists of a collection of informative reports that deal with all relevant uncertainty sources that may be encountered during EMC compliance tests. Typical examples of uncertainty sources are the product itself, the measurement instrumentation, the set-up of the product, the test procedures and the environmental conditions

Part 4-2, deals with a limited and specific category of uncertainties (i.e. the measurement instrumentation uncertainties). In Part 4-2, examples of measurement instrumentation uncertainty budgets are given for most of the CISPR test methods. In this part also requirements are given on how to incorporate the measurement instrumentation uncertainty in the compliance criterion.

If a compliance test is performed using different samples of the same product, then the spread of the EMC performance of the product samples shall be incorporated also in the compliance criterion Part 4-3 deals with the statistical treatment of test results in case compliance test are performed using samples of mass-produced products. This treatment is well known as the 80 %-80 % rule

Many important decisions are based on the results of EMC tests The results are used, for example, to judge compliance against specifications or statutory requirements. Whenever decisions are based on EMC tests, it is important to have some indication of the quality of the results, that is, the extent to which they can be relied on for the purpose in hand. Confidence in test results obtained outside the user's own organisation is a prerequisite to meeting this objective. In the sector of EMC it is often times a formal (frequently legislative) requirement for test laboratories to introduce quality assurance measures to ensure that they are capable of and are providing results of the required quality Such measures include: the valid use of standardized test methods, the use of defined internal quality control procedures; participation in proficiency testing schemes, accreditation to ISO 17025; and establishing traceability of the results of the tests

As a consequence of these requirements, EMC test laboratories are, for their part, coming under increasing pressure to demonstrate the quality of their test results. This includes the degree to which a test result would be expected to agree with other test results (reproducibility using the same test method), normally irrespective of the methods used (reproducibility using alternative test methods). A useful means to demonstrate the quality of standardized EMC tests is the evaluation of the associated uncertainty

Although the concept of measurement uncertainty has been recognised by EMC specialists for many years, it was the publication of the 'Guide to the Expression of Uncertainty in Measurement' (the GUM) by ISO in 1993, and the publication of the EMC specific NAMAS publication NIS 81 on 'The treatment of Uncertainty in EMC measurements' in 1994, which established general and EMC specific rules for evaluating and expressing uncertainty of EMC measurements.

In contrast to classical metrology problems, in EMC there has been great emphasis on precision of results obtained using a specified and standardized method, rather than on their traceability to a defined standard or SI unit This has led to the use of standardized test methods, such as the CISPR standards, to fulfil legislative and trading requirements Furthermore, in EMC tests the magnitude of the intrinsic uncertainty (mainly due to reproducibility problems of the set-up of products and their cabling) is large compared to the uncertainties induced by the measurement instrumentation and test procedure These two important differences between EMC test methods and classical metrology tests, makes it necessary to give specific guidance for evaluating uncertainties of EMC tests, in addition to the generic uncertainty guides like the aforementioned ISO Guide (GUM) on measurement uncertainties.

CISPR 16-4-1 consists of a collection of informative reports that deal with all relevant uncertainty sources that may be encountered during EMC compliance tests Typical examples of uncertainty sources are the product itself, the measurement instrumentation, the product set-up, the test procedures and the environmental conditions This CISPR document shows how the concepts given in the ISO Guide may be applied in standardised EMC tests. The EMC-specific basic uncertainty aspects of both emission and immunity tests are outlined in Clauses 4 and 5 respectively These basic concepts include the introduction of the different types of uncertainties relevant in EMC tests and also the various typical categories of uncertainty sources encountered This is followed by a description of the steps involved in the evaluation and application of uncertainties in EMC tests.

# TABLE RECAPITULATING CROSS-REFERENCES

| First edition of CISPR 16-4-1 Clauses | First edition of CISPR 16-3 Clauses |
|---|---|
| 1 | 1 (of document CISPR/A/450/DTR) |
| 2 | 2 (of document CISPR/A/450/DTR) |
| 3 | 3 (of document CISPR/A/450/DTR) |
| 4 | 4 (of document CISPR/A/450/DTR) |
| 5 | Reserved |
| 6 | 6 3 |
| 7 | Reserved |
| 8 | Reserved |
| 9 | Reserved |
| 10 | Reserved |
| Annexes | Annexes |
| A | A (of document CISPR/A/450/DTR) |
| B | B (of document CISPR/A/450/DTR) |

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