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SERIES K: PROTECTION AGAINST INTERFERENCE

Preparation of emission and immunity requirements for telecommunication equipment – General principles

ITU-T Recommendation K.42

(Previously CCITT Recommendation)

ITU-T K-SERIES RECOMMENDATIONS

PROTECTION AGAINST INTERFERENCE

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION K.42

PREPARATION OF EMISSION AND IMMUNITY REQUIREMENTS FOR TELECOMMUNICATION EQUIPMENT – GENERAL PRINCIPLES

Summary

This Recommendation explains the basic principles on which EMC standardization is based in ITU-T taking into account EMC standards published by IEC and CISPR. It describes procedures which are followed in the preparation of ITU-T Recommendations on Electromagnetic Compatibility (EMC) requirements which apply to telecommunications equipment. Recommendations concerning resistibility requirements for equipment as well as EMC characteristics of telecommunications networks, mitigation methods, bonding and earthing, etc. are outside the scope of this Recommendation.

Source

ITU-T Recommendation K.42 was prepared by ITU-T Study Group 5 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 15th of May 1998.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Recommendation K.42

PREPARATION OF EMISSION AND IMMUNITY REQUIREMENTS FOR TELECOMMUNICATION EQUIPMENT – GENERAL PRINCIPLES

(Geneva, 1998)

1 Scope

This Recommendation applies to EMC requirements for telecommunications equipment as they are recommended to be drafted in ITU-T Study Group 5 in particular and in other Study Groups as appropriate. The principles and procedures described should be followed in order to ensure that the resulting Recommendations are consistent with each other, with current practice and with IEC publications concerning EMC. The aim is to avoid duplication of work and overlapping document scopes, taking carefully into account EMC activities in IEC.

Recommendations on resistibility requirements for telecommunications equipment are for the moment outside the scope of this Recommendation but may be added to updated editions.

EMC Recommendations concerning other parts of the telecommunications network than equipment, e.g. mitigation methods in the network, earthing and bonding, are outside the scope of this Recommendation.

2 Definitions

Definitions relating to EMC are given in IEC 50 (161): International Electrotechnical Vocabulary, Chapter 161, Electromagnetic Compatibility [1]. In addition to **electromagnetic compatibility: EMC** itself, essential terms are **electromagnetic environment**, **electromagnetic disturbance**, **electromagnetic interference**, **emission** and **immunity**. Especially it should be noted that "disturbance" and "interference", often used indiscriminately, in the context of EMC are used to mean "cause" and "effect" respectively.

2.1 **high frequency**: Should be used to refer to frequencies above 9 kHz. Consequently it embraces all radio frequencies.

2.2 **low frequency**: Should be used to refer to frequencies below 9 kHz.

2.3 **port**: Is a particular interface of the equipment which couples this equipment with or is influenced by the external electromagnetic environment. The **enclosure port** is the physical boundary of the equipment which provides for radiated and electrostatic discharge energy transfer, whereas the **AC power port**, the **DC power port** and the **signal/control port** provide for conducted energy transfer.

3 References

[1] IEC 60050-161 (1990), *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic Compatibility*.

[2] ITU-T Recommendation A.23 (1996), *Collaboration with the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) on Information technology.*

[3] IEC Guide 107 (1998), *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*.

[4] IEC 61000, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques*.

IEC 61000-4-1:1992, *Overview of immunity tests*.

IEC 61000-4-2:1995, *Electrostatic discharge immunity test*.

IEC 61000-4-3:1995, *Radiated, radio-frequency, electromagnetic field immunity test*.

IEC 61000-4-4:1995, *Electrical fast transient/burst immunity test.*

IEC 61000-4-5:1995, *Surge immunity test*.

IEC 61000-4-6:1996, *Immunity to conducted disturbances, induced by radio-frequency fields*.

IEC 61000-4-7:1991, *General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*.

IEC 61000-4-8:1993, *Power frequency magnetic field immunity test*.

IEC 61000-4-9:1993, *Pulse magnetic field immunity test.*

IEC 61000-4-10:1993, *Damped oscillatory magnetic field immunity test*.

IEC 61000-4-11:1994, *Voltage dips, short interruptions and voltage variations immunity tests*.

IEC 61000-4-12:1995, *Oscillatory waves immunity test.*

IEC 61000-4-15:1997, *Flickermeter – Functional and design specifications*.

IEC 61000-4-16:1998, *Test for immunity to conducted common mode disturbances in the frequency range 0 Hz to 150 kHz*.

IEC 61000-4-17, *Ripple on DC power supply*.

IEC 61000-4-20, *TEM Cells*.

IEC 61000-4-23, *Test methods for protective devices for HEMP radiated disturbances*.

IEC 61000-4-24:1997, *Test methods for protective devices for HEMP conducted disturbance*.

IEC 1000-4-28, *Variation of power frequency*.

[5] CISPR 24, *Information Technology Equipment – Immunity characteristics – Limits and methods of measurement (FDIS)*.

[6] IEC Publication 721 (Series), *Classification of environmental conditions*.

[7] CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*.

[8] IEC 61000, *Electromagnetic compatibility (EMC) – Part 3: Limits*.

IEC 61000-3-2:1995, *Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*.

IEC 61000-3-3:1994, *Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A.*

4 EMC standardization

4.1 General principles

ITU-T Recommendation A.23 [2] recognizes the need of collaboration with the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). This applies also to the standardization in the EMC field where close cooperation with IEC is essential in order to avoid conflicting measurement and test methods and duplication of work. In accordance with agreements reached in Study Group 5, this Recommendation is partly based on IEC Guide 107 [3] prepared by the Advisory Committee on Electromagnetic Compatibility (ACEC) of IEC.

Two technical committees with horizontal functions have responsibility for developing EMC standards in IEC. The International Special Committee on Radio Interference (CISPR) is responsible for emissions above 9 kHz and has prepared also immunity requirements for certain product families. Technical Committee 77: Electromagnetic

Compatibility is responsible for emissions below 9 kHz and for developing the basic standards for immunity testing. Different product committees in IEC preparing product or product family specific EMC standards are obliged to use the emission limits and to refer to the basic immunity standards in their specifications.

In accordance with agreements reached in Study Group 5, ITU-T should, as far as possible, follow the same general principles as IEC product committees in the EMC Recommendations. Applying the same emission limits ensures uniformity and maintains control of the electromagnetic environment and guarantees that acceptable compatibility levels and disturbance levels are respected. This is especially true for environments over which the telecommunications operator has no control. Referring to common measurement methods gives economic advances when the same test procedures, equipment and arrangements can be used for testing all kind of electrical and electronic equipment.

Recommended practice on the application of these principles is given later in more detail. It should be noted that in justified cases it is possible to deviate from IEC publications. One reason may be the high priority of service required from the public telecommunications network equipment providing service for a large number of demanding customers.

4.2 Types of EMC Standards/Recommendations

EMC publications developed in IEC are placed broadly in four categories which also other standardization bodies including ITU-T should follow. These four categories are basic EMC publications, generic EMC standards, product family EMC standards and product EMC standards. ITU-T, publishing mainly Recommendations comparable either to standards or to technical reports of IEC, is recommended to apply the categories as described in the following subclauses.

4.2.1 Basic EMC publications

Basic EMC publications give the general and fundamental conditions or rules for the achievement of EMC and serve as reference documents for generic, product family and product standards. They are general and hence are not dedicated to specific product families or products. In IEC, basic publications may be standards or technical reports.

Basic EMC publications may concern in particular:

– terminology;

– descriptions of electromagnetic phenomena;

– descriptions and classification of the electromagnetic environment;

– test and measurement techniques.

To avoid duplication of work and conflicting standards, ITU-T should as much as possible make use of basic EMC publications prepared by IEC. Test and measurement techniques which are not product dependent should apply IEC 61000-4-Series [4] standards as far as possible. Some test methods, e.g. the longitudinal mains induction test, may not be general enough to be included in IEC standards. Such a Recommendation should be treated as a basic EMC Recommendation of ITU-T. Also Recommendations on conditions which are under control of telecom operators or Administrations, e.g. environmental classification of telecommunications centres, should be prepared in ITU-T and treated as basic EMC Recommendations of ITU-T.

ITU-T should inform IEC on work items intended to prepare basic EMC Recommendations and any needs to amend basic EMC publications of IEC from the telecommunications point of view.

4.2.2 Generic EMC Standards/Recommendations

Generic EMC standards apply to products operating in a particular environment for which no dedicated product family/ product EMC standard exists. They specify a set of requirements, test procedures and generalized performance criteria applicable to such products operating in this environment.

Generic EMC standards do not include detailed measurement and test methods but refer for that purpose to the basic EMC standards. They concern requirements and tests related to emission and immunity, possibly in separate documents. The number of tests is limited to essential ones.

Generic EMC ITU-T Recommendations should be provided for such cases where there is no product family EMC Recommendation.

4.2.3 Product family EMC Standards/Recommendations

A product family is a group of similar products for which the same standards can be applied.

Product family EMC Standards/Recommendations define specific EMC requirements and test procedures dedicated to particular product families. They indicate the selected tests and operational conditions during testing, test severities (test levels) and precise performance criteria in immunity tests and limits for conducted and radiated disturbances in emission measurements. They should not contain detailed measurement and test methods and test set-ups but should refer to the basic EMC standards where possible.

For terminal equipment, application of the product family standard prepared in IEC CISPR is recommended [5]. For all other telecommunications equipment, ITU-T should consider preparing product family EMC Recommendations.

4.2.4 Product EMC Standards/Recommendations

Product EMC Standards/Recommendations relate to a particular type of product for which specific conditions should be considered. The same rules apply as for the product family EMC Standards/Recommendations.

Product EMC Recommendations may be prepared by ITU-T, e.g. in the case where a certain type of product needs more stringent requirements than specified for the product family it belongs to, e.g. due to high priority of service requirements. An example could be cross-connect equipment of SDH systems serving several high capacity line systems.

5 Principles on environmental classification

The electromagnetic environment varies from time to time and from place to place in a very complicated manner. It is not feasible to work out a complete description of the electromagnetic environmental conditions. The concept of environmental classes introduced by IEC for climatic and mechanical environments [6] takes into account the complex spatial and temporal behaviour of environmental exposures and offers a systematic and standardized approach on which test requirements can be based.

It is typical of the electromagnetic disturbances that they are more severe at some locations than at others. It is therefore natural to define environmental classes based on the locations where telecommunications equipment is typically installed and used. An environmental class is a systematic representation of the environment for a family of locations with similar properties. It is like an envelope of a group of related environments composed of environmental parameters which may be assumed to influence equipment performance. An environmental class is normally specified by a verbal description and by characteristic severities of the relevant environmental parameters, representing an extreme (99 %) point of the statistical severity distribution of each exposure.

The environmental classes constitute a basis for the test specifications, giving one criterion to choose immunity test severities for equipment. The characteristic severity of each environmental parameter in an environmental class may or may not be selected as the test severity. Other factors, e.g. the importance (priority of service) of the equipment, failure consequences, performance level and other economic and technical considerations are important factors on which the test severities are based.

6 Developing product family/product EMC Recommendations

6.1 General

The EMC Recommendations for product families should be drafted in ITU-T SG 5 as one or more publications. Other Study Groups may see the need to include EMC requirements for a particular product in a general product-related Recommendation. These EMC requirements should be coordinated with the Recommendations prepared by Study Group 5.

6.2 Emission

After identification of the relevant disturbances applicable to the product family/product, emission requirements should be based on IEC and CISPR publications and, as long as radio transmitters are concerned, on ITU-R Recommendations. At least references [7] (conducted and radiated radio frequency disturbances) and [8] (harmonics on AC power port and voltage fluctuations on AC power port) should be consulted. The requirements may be expressed either as simple reference or the limits may be copied to the ITU-T Recommendation without altering them in any way. A selection between alternative limits should be done to clearly specify which limit shall be fulfilled.

6.3 Immunity

For the specification of immunity requirements in product family EMC Recommendations, the following procedure is recommended:

a) Identify relevant disturbances for the product concerned and the environments where it is intended to operate.

b) Choose test levels from the values recommended in the corresponding basic standards, so as to allow the use of standardized test equipment, taking into account the environmental class, the importance (priority of service) of the equipment, failure consequences, performance level and other economic and technical considerations. Graded testing with several test levels selected to correspond to different performance criteria [see e) below] is recommended.

c) Specify the number and duration of the immunity tests on the basis of the basic standard.

d) Specify the operational conditions during immunity testing, e.g. operational mode, number of lines to be driven during testing, termination of ports, connections and auxiliary equipment.

e) Specify the performance criteria in detail and precisely based on the general criteria given by IEC and CISPR and the guidance given in 6.4 below.

6.4 Guidance for setting performance criteria in product family/product Recommendations

Particular performance criteria on immunity should be based on the following principles:

Performance criterion A

– A1: The equipment shall continue to operate as intended without operator intervention. The EUT shall operate correctly within the limits defined in the equipment performance specification.

– A2: Reduced performance is permitted within specified relaxed limits during the test. Resumption to correct operation within the limits defined in the equipment performance specification shall occur at the cessation of the test.

Performance criterion B

Temporary loss of function following application of the test is permitted. At the cessation of the test, the equipment shall return to its normal operation conditions within an appropriate time. No change of operating state or stored data is allowed to persist after the test.

Performance criterion C

Loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. Functions or information stored in non-volatile memory or protected by a battery back-up shall not be lost.

Other factors

It is essential to take into account the usage and importance of a piece of equipment in setting criteria. For instance, telecommunications network equipment, serving simultaneously a vast number of customers, some using commercial and industrial services of extremely high importance, needs more consideration than ordinary consumer appliances. It is crucial to be able to ascertain that telecommunications network equipment works without any additional errors above those accepted in the performance specification of the product family concerned under "normal" exposure level of both continuous and transient disturbances. It is also crucial to establish that the equipment does not fail catastrophically at a slightly increased test level representing a less likely environmental event. In some EMC tests, being potentially destructive, it has to be ensured that permanent damage does not occur.

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