ITUPublications
Recommendations

International Telecommunication Union
Standardization Sector

Recommendation

ITU-T K.38 (01/2024)

SERIES K: Protection against interference

Radiated emission test procedure for physically large systems

Recommendation ITU-T K.38

Radiated emission test procedure for physically large systems

Summary

Recommendation ITU-T K.38 specifies the technical requirements for the radiated emission measurement procedure for physically large systems used within the public telecommunication network. A minimum representative system is defined, which is used for compliance testing of physically large telecommunication systems.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T K.38	1996-10-18	5	11.1002/1000/3876
2.0	ITU-T K.38	2024-01-13	5	11.1002/1000/15775

Keywords

EMC, large system, radiated emission.

* To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. 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, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T K.38

Radiated emission test procedure for physically large systems

1 Scope

This Recommendation specifies the technical requirements for the radiated emission measurement procedure for physically large systems used within the public telecommunication network, with the exception of radio equipment.

It applies to physically large systems which are comprised of equipment or systems requiring installation documentation specific for those sites at which they are to be installed. In order to demonstrate compliance of such systems, a minimum representative system is defined, which is used for compliance testing. Installations built from units of the complying minimum representative system are deemed to satisfy the radiated emission requirements.

The minimum representative system is representative of installed systems in terms of function (which includes at least one of each functional unit type) and electromagnetic radiation characteristics. The minimum representative system is subsequently referred to in this Recommendation as the equipment under test (EUT), to be used for compliance testing.

Minimum representative systems shall be tested on an open area test site (OATS) or in a suitable chamber, the limits to be used are those as specified in [IEC CISPR 32].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[IEC CISPR 16-1-1] IEC CISPR 16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*.
<https://webstore.iec.ch/publication/60774>

[IEC CISPR 16-1-4] IEC CISPR 16-1-4:2019+AMD1: 2020+AMD2:2023, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements*.
<https://webstore.iec.ch/publication/84775>

[IEC CISPR 32] IEC CISPR 32:2015+AMD1: 2019, *Electromagnetic compatibility of multimedia equipment –Emission requirements*.
<https://webstore.iec.ch/publication/65836>

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 antenna reference point [IEC CISPR 16-1-4]: midpoint of an antenna from which the distance to the EUT or second antenna is measured.

NOTE – The antenna reference point is either defined by the manufacturer using a marker on LPDA antennas or by the calibration laboratory.

3.1.2 emission [b-IEC 60050-161], [IEV 161-01-08]: The phenomenon by which electromagnetic energy emanates from a source.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 system: A set of subsystems which, when connected together, produce a fully operational product and is intended to be marketed as such.

3.2.2 subsystem: A grouping of functional units which perform specific functions within the host system, and which communicate with other equipment via well-defined interfaces and protocols.

3.2.3 functional unit: A grouping of electronic hardware which performs specific functions, but may be connected with other functional units to produce the required subsystem.

3.2.4 new functional module: A replacement and/or addition for any grouping or arrangement of electronic hardware (with its associated mechanical packaging and interconnections), which enhances or improves the system operation.

3.2.5 test site: This should be an open area test site (OATS), with reflecting ground plane, or a suitable chamber with reflecting ground plane.

3.2.6 minimum representative system: A system that is representative of installed systems in terms of function (which includes at least one of each functional unit type) and electromagnetic radiation characteristics. This shall be equipped to at least the minimum configuration which could be offered for sale for use as an actual system. It excludes any operational equipment connected for the purpose of monitoring or system measurements and which are connected for a temporary period. An example of how the equipment under test (EUT) is to be selected is given in Figure 1.

3.2.7 cable distribution point: The cable distribution point is the interface at which cabling shall be terminated; this unit is the point at which cabling from the system is connected to the cabling from external units.

3.2.8 physically large system: A group of racks or cabinet functionally connected to form a commercially specified system, which has a total dimension exceeding that which is practical for testing on a conventional 10 m test site.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

EUT Equipment Under Test

OATS Open Area Test Site

5 Conventions

None.

6 Minimum representative system

The recommended method for determining the minimum representative system is given here.

6.1 Determination of minimum representative system

The minimum representative system is a system which contains the minimum number of units needed to perform all functions specified for the system.

6.2 New functional modules

Functional modules used in the system tests may be individually characterized in a defined test facility (see clause 7.1). This characterization may then be used as a reference to determine the effect of any significant design changes.

Using this technique, the performance of new functional modules may be assessed and the test plan, written in such a way as to demonstrate that the representative system continues to conform when a functional module has been replaced by a new functional module. The results obtained for new functional modules shall be compared with those from the previous module.

The manufacturer shall clearly demonstrate and document the reasons why a new functional module does not require a complete representative system retest. If the module constitutes a major change to the system configuration, a complete representative system test shall be performed.

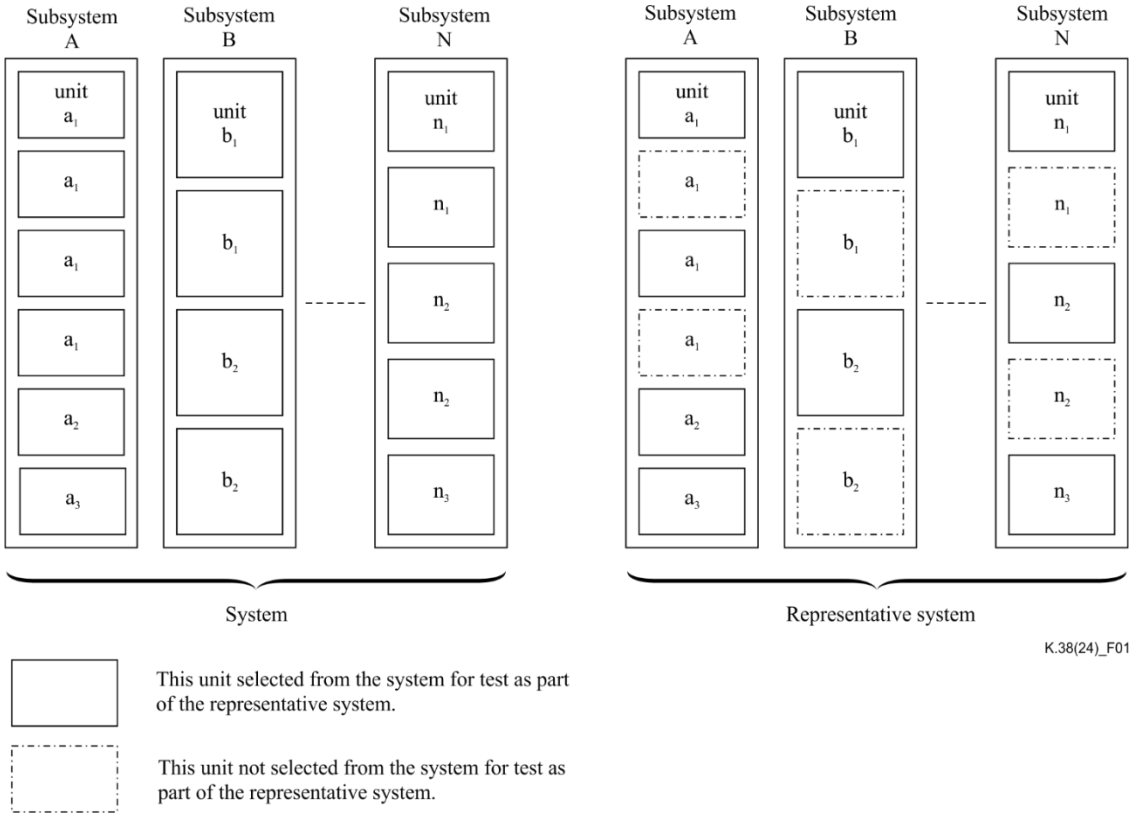


Figure 1 – Example of selection of a representative system

7 General operational conditions

7.1 Equipment configuration

The equipment under test (EUT) shall conform to the manufacturer's normal installation practice. There exists for each EUT a minimum set of interface lines which is required for the operation of the system and this number shall be defined for each EUT and identified in the test report.

The EUT shall be assembled in such a way that emissions are maximized within any limitations imposed by normal installation practice.

7.1.1 Equipment boundary

For the purpose of determining the equipment boundary, from which the tests distance is taken, the equipment boundary shall be the straight line envelope around the EUT, this includes the cables specified for attachment to the EUT for the purpose of test. Measurement distances are to be taken from this line.

7.2 Equipment cable layout

7.2.1 Intra-system cabling

All cables internal to the system, and used for its operation, shall be connected and be of such a length and type required for the normal operation of the system. These shall be routed in accordance with the relevant system installation instructions, such that these are typical of an installed system.

The system shall normally be configured in accordance with [IEC CISPR 32] requirements for floor standing equipment. An alternative set-up using a raised floor is acceptable for systems operated in this way.

If raised floor systems are characterized as the worst case and used for testing, and if the inter-unit cable routing is into the raised floor system, the effect of the raised floor system shall be examined. The raised floor shall be left in place if it forms part of the system screen, but where the raised floor is not intended to be used as a screen then, in order to prevent incidental screening of emissions, the floor panels shall be removed for the duration of the test.

7.2.2 Interface cabling

Cables between the system, the distribution point and external units, shall be of the type as specified by the system supplier or as detailed by customer requirements, and shall follow the relevant system installation practice. Care must be taken to ensure that noise from the test and exercising equipment does not contribute to the emissions from the representative system. The method of orientating and terminating the cables shall be noted in the test report.

The emission contributions from the system, cables and distribution point (where all of these elements are involved) are difficult to separate; there are two cases to be considered:

1) unscreened cable systems;

2) screened cable systems.

Screening is achieved by one of two methods:

a) by use of screened cabling;

b) by the use of a screened floor or ducted systems in which unscreened cabling is run.

Measurement of these installation practices is performed as described in clauses 7.2.2.1 and 7.2.2.2.

7.2.2.1 Unscreened cable systems

Wherever the distribution point is located, measurement shall be made using a length of unscreened cabling configured as described in clauses 7.2.2.1.1 and 7.2.2.1.2. Beyond this minimum length, the

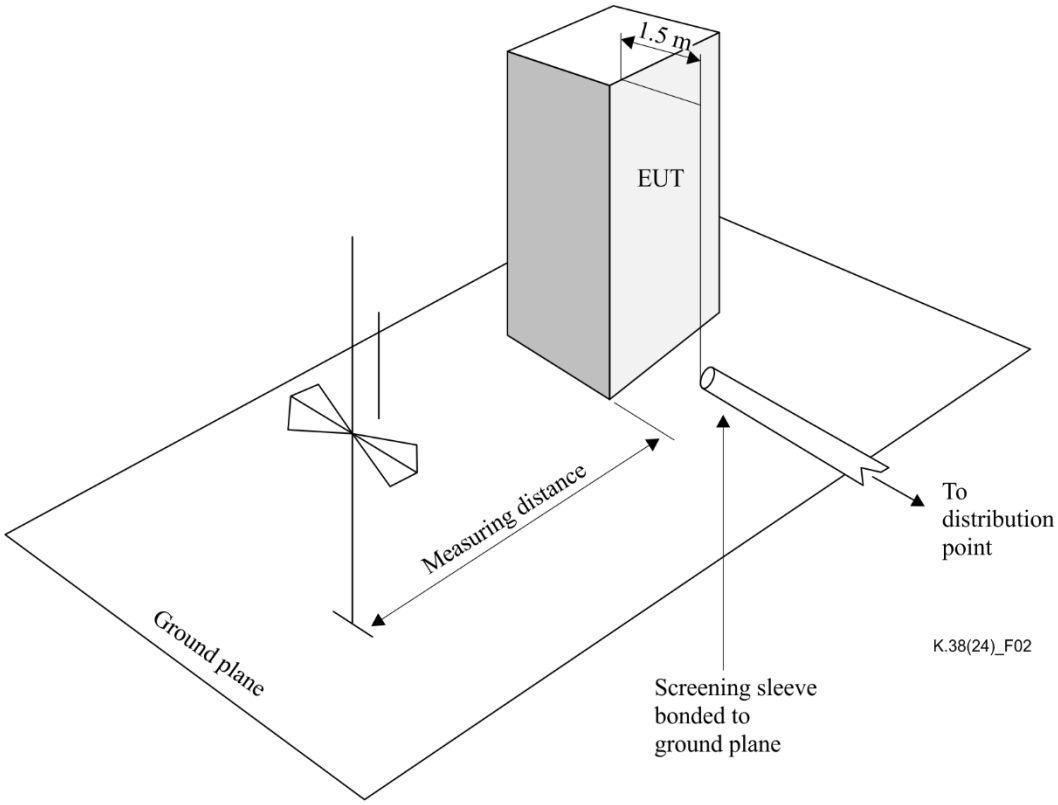
cabling shall be taken off the measurement site below the ground plane to the exercising equipment. Where this is not practicable, the cabling may run in screened sleeving which is bonded to the measurement site ground plane.

Two types of cable installation practice shall be considered.

7.2.2.1.1 Overhead cable systems

An overhead cable system is defined as one where cables are routed above the equipment. From the cable exit point of the EUT, all cabling shall run perpendicularly from the EUT in the horizontal plane for 1.5 metres before dropping to the ground plane.

Support of the cabling shall be of the type specified by the system supplier, or as detailed by customer requirements, and shall follow the relevant system installation practice. Where the system supplier or customer do not specify cable supports, then non-conducting unscreened cable supports shall be used. The height and position of the cables shall be noted in the test report (see Figure 2). The cabling shall be taken off the measurement site below the ground plane to the exercising equipment. Where this is not practicable, the cabling may run in screened sleeving which is bonded to the measurement site ground plane.



NOTE 1 – The EUT is separated from the ground plane with an electrically isolating support, and electrically bonded to the site power supply ground using normal installation practice as possible.

NOTE 2 – For clarity, only a single rack EUT is shown.

NOTE 3 – It is acceptable to test with the cable supported at the height of the rack if this is a normal installation practice.

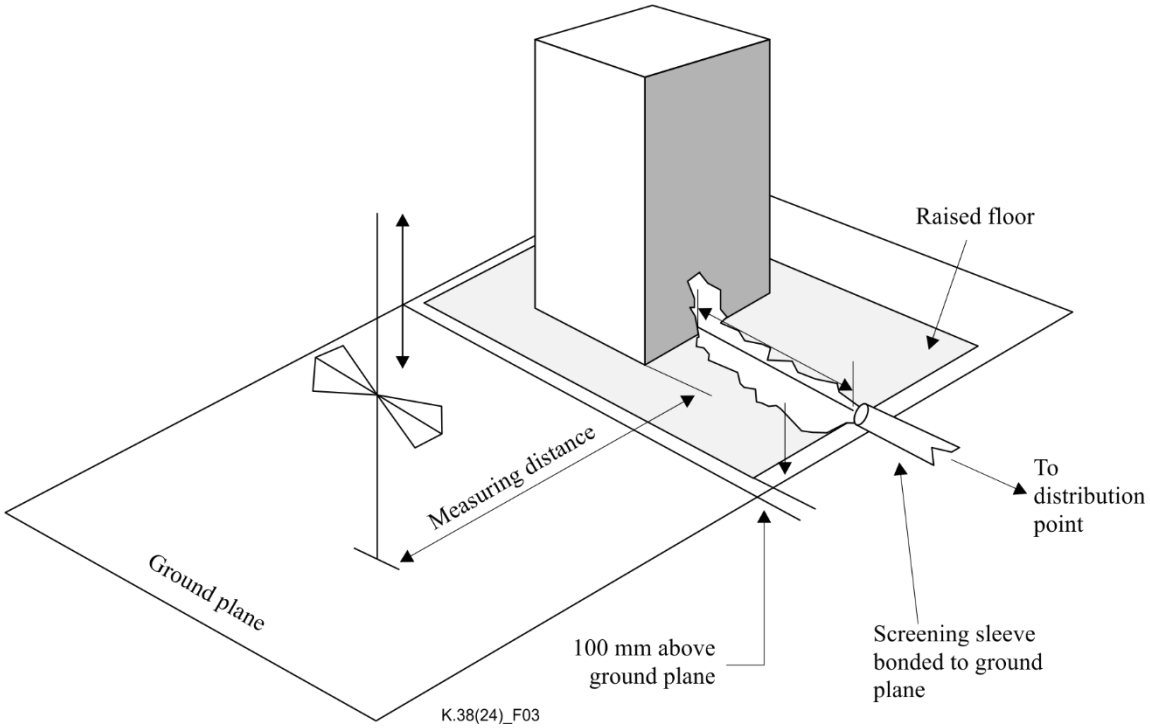
Figure 2 – Overhead cable systems – Example for a test set-up

7.2.2.1.2 Raised floors

Where a raised floor system is used during testing (but the raised floor does not form part of the screen) then all cabling will drop through the raised floor towards the ground plane and run perpendicularly from the EUT in the horizontal plane for 1.5 metres, the raised floor being removed

(see clause 7.2.1). The cabling shall leave the measurement site below the ground plane to the exercising equipment. Where this is not practicable, the cabling may run in screened sleeving, which is bonded to the measurement site ground plane. All exposed, unscreened cabling, shall be on a support at a height of 10 cm (see Figure 3).

The support shall be of the type specified by the system supplier, or as detailed by customer requirements, and shall follow the relevant system installation practice. Where the system supplier or customer do not specify cable supports, then non-conducting, unscreened cable supports shall be used.



NOTE 1 – If the raised floor does not form part of the screen, the floor panels are removed. The raised floor is isolated from the EUT screen.

NOTE 2 – For clarity, only a single rack EUT is shown.

Figure 3 – Raised floor – Example for a test set-up

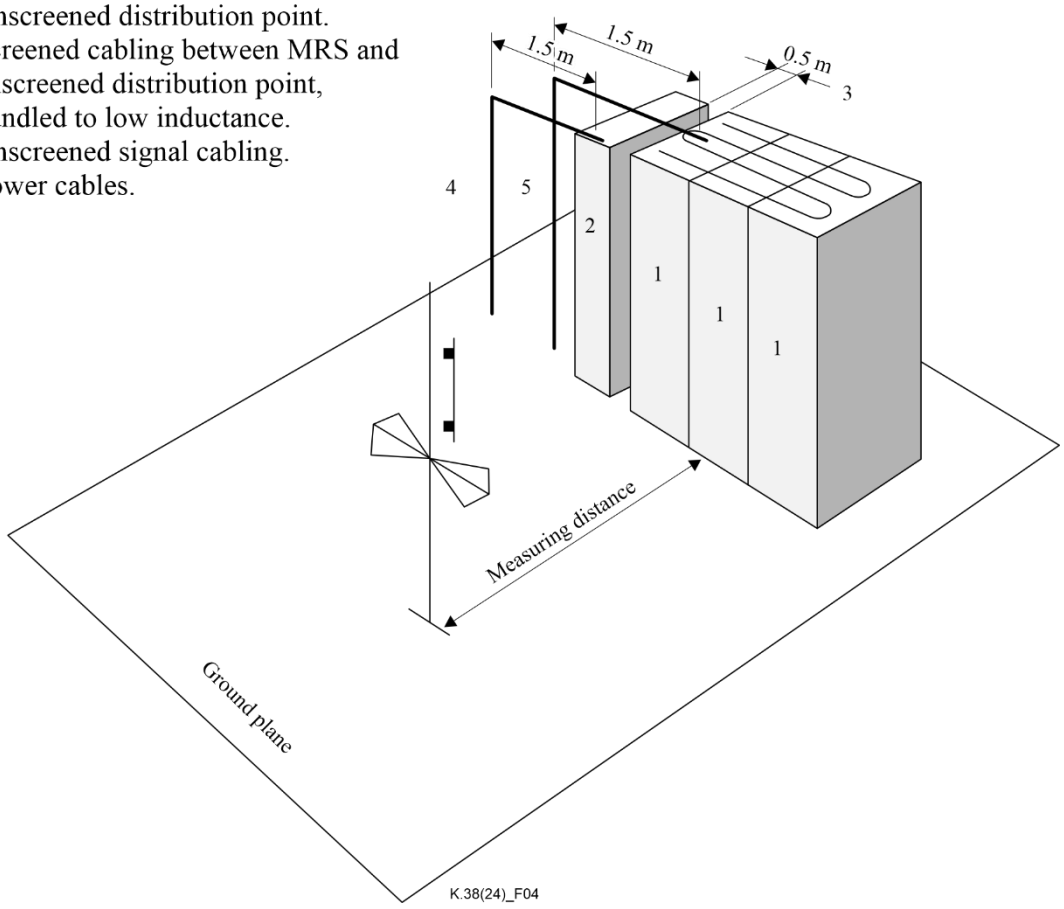
7.2.2.2 Screened cable systems

Where a screened cabling system is used throughout the installation, cabling typical of the installation practice shall be used during testing. Co-axial cables connected to the system is an example of screened cabling.

Where screened cabling is used between a system and an unscreened distribution point, and unscreened cabling is used beyond that point, then a test configuration shall be adopted which exposes the unscreened cabling to the measurement antenna. This shall be achieved by arranging the EUT with an unscreened distribution point located at the closest possible point to the system and forming part of the EUT. The unscreened cabling shall then be exposed, following the principles defined in clause 7.2.2.1.

The length of screened cabling between the system and the unscreened distribution point shall be the minimum length which could be used on any real installation. This minimum length shall be defined by the system supplier and the excess length shall be bundled for low inductance. This length should be 10 m, unless otherwise specified. Figure 4 shows an example of such a test set-up.

1 Minimum representative telecommunication system (MRS). For clarity a three-rack configuration is shown.
2 Unscreened distribution point.
3 Screened cabling between MRS and unscreened distribution point, bundled to low inductance.
4 Unscreened signal cabling.
5 Power cables.



NOTE – Antenna scanned in height between 1 and 4 metres for horizontal and vertical polarization.

Figure 4 – Screened cable system with unscreened distribution point – Example for a test set-up

7.3 Associated equipment

Associated equipment to exercise and/or monitor the EUT shall be sufficiently isolated from the EUT itself such that they do not significantly influence the test results.

7.4 Laboratory environment

Unless otherwise specified, the test environment shall conform to the manufacturer's operating climatic conditions for the equipment.

7.5 Test site

The test site for measurements in the frequency range 30 MHz to 1000 MHz shall comply to the site validation requirement defined in [IEC CISPR 16-1-4] in all directions of the position of the receive antenna.

Test site for measurements above 1 GHz does not require to add the floor absorbers as defined in [IEC CISPR 16-1-4] because impractical for test of large systems as defined in this Recommendation.

8 Measurement method

The EUT shall be working in accordance with its functional specification, and should be exercised as fully as necessary during testing, to ensure that the maximum emissions are achieved.
Where the EUT is not capable of being mounted on a turntable, it shall be assembled on the ground plane (but isolated from it).

8.1 Measurement method from 30 MHz to 1000 MHz

The antenna shall be placed at 10 m from the border of the EUT, with cable layout as described in clause 7.2 and with reference to Figures 2, 3 and 4.

Measurements shall be made at a minimum of 8 angles to ensure compliance of the system (see Figure 5).

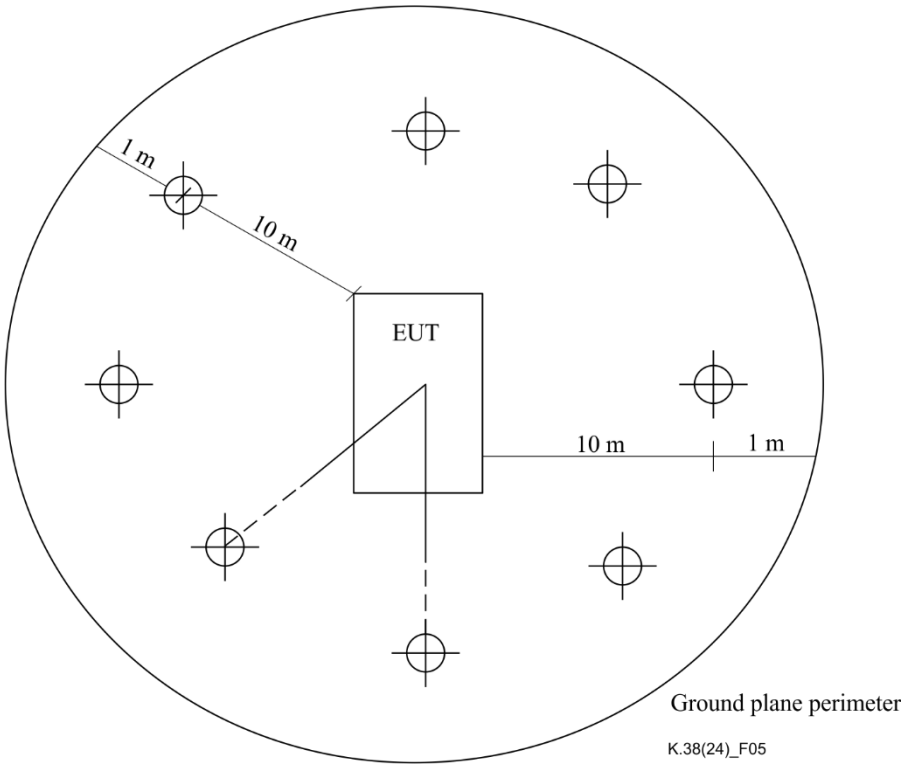
The antenna shall be scanned in height between one and four metres in order to maximize the level of the received emissions. Measurement shall be made in both horizontal and vertical polarizations.

8.2 Measurement method above 1000 MHz

The antenna shall be placed at 3 m from the border of the EUT, with cable layout as described in clause 7.2 and with reference to Figures 2, 3 and 4.

Measurements shall be made at a minimum of 8 angles to ensure compliance of the system (see Figure 5). However, this number can be increased if the beamwidth of the receive antenna is not suitable to cover the surface of the EUT facing the receive antenna in each of the 8 positions.

The antenna shall be scanned in height from one metre until the top of the EUT (i.e., reference point of the receive antenna shall be in line with the top of the EUT) in order to maximize the level of the received emissions. Measurement shall be made in both horizontal and vertical polarizations.



NOTE – The envelope of the EUT in this figure includes the cables as shown in Figures 2, 3, 4.

Figure 5 – Angles of measurement

9 Measurement instrumentation uncertainty

Measurement instrumentation uncertainty may be determined applying the criteria defined in [b-IEC CISPR 16-4-2]

10 Test results report

The test report shall include all test conditions and results together with the methods of test used. The selection shall show that the functional units so tested are those that would form the basis of a minimum installable system. Included in the test report shall be:

a) selection procedure for the EUT;

b) reasons for the selection of those functional units;

c) description of cable layout;

d) description of actions taken to maximize the emissions from the EUT;

e) a description of the exercising equipment used to exercise the EUT;

f) a detailed description of the operational modes of the EUT used during the tests;

g) a description of the test conditions including photographs and plan of the site and EUT where appropriate;

h) the test results;

i) a statement regarding the calibration status of the test equipment;

j) a description of the test site;

k) the measurement instrumentation uncertainty;

l) a detailed description of the equipment comprising the EUT;

m) a description of the software used to exercise the EUT.

Bibliography

[b-IEC 60050-161] IEC 60050-161: 1990/AMD10: 2021, *International Electrotechnical Vocabulary (IEV). Part 161: Electromagnetic compatibility*.
<http://webstore.iec.ch/webstore/webstore.nsf/artnum/000397>

[b-IEC CISPR 16-4-2] IEC CISPR 16-4-2:2011+AMD1:2014+AMD2:2018, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Measurement instrumentation uncertainty*.
https://webstore.iec.ch/publication/63750

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	**Protection against interference**
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems

Published in Switzerland
Geneva, 2024