ETSI TS 103 569 V1.1.1 (2020-11)

ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Study into extending the upper limit of the range of radiated emissions requirements up to 40 GHz

Reference

DTS/ERM-EMC-366

Keywords

EMC, emission

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Contents

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document defines requirements for radiated emissions from 6 GHz to 40 GHz. It includes limits and test methodologies.

With the need for faster digital communications, at higher bandwidths, means that today's internet technologies have to use Gbps (Gigabyte per second) signals in TNE (including MME, ICT and IMT equipment) to satisfy the growing demand. In addition to traditional wired communication, wireless devices (radio base stations, Wi-Fi® systems, NR) also operate at, and use these higher frequencies. Hence there is need to protect the spectrum to allow efficient communication. Consequently, the risk of wireless systems being disturbed electromagnetically by unintentional digital noise has increased significantly over the last few years in the frequency band above 6 GHz.

1 Scope

The aim of the present document is to control unintentional radiated emissions generated by digital devices to protect radio services operating at frequencies up to 40 GHz.

The upper frequency limit of 6 GHz for unintentional radiated electric field emissions within current ETSI EMC standards is insufficient to protect these higher frequencies. Therefore, there is a need to develop requirements to control higher frequency digital noise to improve EMC. Within the present document, the upper limit of the frequency range is extended to 40 GHz and includes the following main elements:

- radiated electric field emission limits for unintentional signals;
- test site specifications;
- measurement methods;
- uncertainty analysis.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] EN 55032 (2015 + Amendment 1:2020): "Electromagnetic compatibility of multimedia equipment - Emission Requirements" (produced by CENELEC).

NOTE: When referencing to EN 55032, Table clause x.y, wx denotes the table and y denotes the referenced clause by row within the table. For example table clause 2.3 is Table 2, clause (row) 3.

[2] CISPR 16-1-4 (2019): "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".

[3] CISPR 16-2-3 (2016 + Amendment 1:2019): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements".

[4] ANSI C63.2 (2016): "American National Standard For Specifications of Electromagnetic Interference and Field Strength Measuring Instrumentation in the Frequency Range 9 kHz to 40 GHz".

[5] CFR Title 47 Part 15 (2020): "Radio Frequency devices".

[6] EN 61000-4-22 (2010): "Electromagnetic compatibility (EMC) - Part 4-22: Testing and measurement techniques - Radiated emissions and immunity measurements in fully anechoic rooms (FARs)" (produced by CENELEC).

[7] 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".

[8] ANSI C63.4 (2014 + Amendment 1:2017): "American National Standard For Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz".

[9] CISPR 16-1-6 (2014 + Amendment 1:2017): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-6: Radio disturbance and immunity measuring apparatus - EMC antenna calibration".

[10] ETSI EN 300 386 (V2.1.1) (07-2016): "Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements; Harmonised Standard covering the essential requirements of the Directive 2014/30/EU".

[11] CISPR 16-1-5 (2016): "Specification for radio disturbance and immunity measuring apparatus and methods -Part 1-5: Radio disturbance and immunity measuring apparatus - Antenna calibration sites and reference test sites for 5 MHz to 18 GHz".

[12] CISPR 32 (2015 + Amendment 1:2019): "Electromagnetic compatibility of multimedia equipment - Emission requirements".

[13] ISO/IEC 17025 (2017): "General requirements for the competence of testing and calibration laboratories".

[14] IEC 61000-4-21 (2011): "Electromagnetic compatibility (EMC) - Part 4-21: Testing and measurement techniques - Reverberation chamber test methods".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] CISPR 11 (2015 + Amendment 1:2016 + Amendment 2:2019): "Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement".

[i.2] EN 55011 (2016 + Amendment A1:2017): "Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement" (produced by CENELEC).

[i.3] Recommendation ITU-T K.136 (2018): "Electromagnetic compatibility requirements for radio telecommunication equipment".

[i.4] Recommendation ITU-T K.137 (2018): "Electromagnetic compatibility requirements and measurement methods for wireline telecommunication network equipment".

[i.5] ICES 003 (2016 + Updated:2019): "Information Technology Equipment (Including Digital Apparatus) - Limits and Methods of Measurement".

[i.6] CISPR 16-4-2 (2011 + Amendment 1:2014 + Amendment 2:2018): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modelling - Measurement instrumentation uncertainty".

[i.7] ETSI TR 102 273-1-1 (V1.2.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties Part 1: Uncertainties in the measurement of mobile radio equipment characteristics; Sub-part 1: Introduction".

[i.8] ETSI TR 102 273-1-2 (V1.2.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 1: Uncertainties in the measurement of mobile radio equipment characteristics; Sub-part 2: Examples and annexes".

[i.9] GB 4824 (2019): "Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

enclosure port: physical boundary of the EUT through which electromagnetic fields may radiate

Equipment Under Test (EUT): equipment being evaluated for compliance with the present document

formal measurement: measurement used to determine compliance

NOTE: This is often the final measurement performed. It may be carried out following a pre-scan measurement. It is the measurement recorded in the test report.

Full Anechoic Room (FAR): enclosure that has six internal surfaces which are lined with radio-frequency-energy absorbing material (i.e. RF absorber) that attenuates electromagnetic energy in the frequency range of interest

highest internal frequency f_x: highest fundamental frequency generated or used within the EUT or highest frequency at which it operates

NOTE: This includes frequencies which are solely used within an integrated circuit.

H_{max}: maximum antenna height scanned during measurements within a FSOATS, for example 4 m

H_{min}: minimum antenna height scanned during measurements within a FSOATS

NOTE: H_{min} is normally at 1 m.

measurement distance (d_2): distance within a FSOATS is the shortest horizontal distance between an imaginary circular periphery just encompassing the EUT arrangement and the calibration point of the antenna

mode of operation: set of operational states of all functions of an EUT during a test or measurement

port: physical interface through which electromagnetic energy enters or leaves the EUT

reference distance (d_1): distance within a FSOATS, at which a limit is specified

3.2 Symbols

For the purposes of the present document, the following symbols apply:

f_x the highest fundamental frequency generated or used within the EUT or highest frequency at which it operates
λ the free space wavelength at the measurement frequency
θ_{3dB} polar angle of the antenna main beamwidth at 3 dB

NOTE: See Figure C.3.

φ_{3dB} azimuthal angle of the antenna main beamwidth at 3 dB

NOTE: See Figure C.2.

D_a the largest dimension of the antenna aperture

w_h maximum horizontal dimension of the 3 dB beamwidth of the receiving on the surface plane of the turntable

NOTE: See Figure C.2.

φ_h the arc angle of maximum horizontal dimension, w_h, on the surface plane of the turntable

NOTE: See Figure C.2.

Δ maximum vertical and horizontal dimension that covers the EUT within the 3 dB beamwidth of the receiving antenna

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

10GE	10 Gigabit Ethernet
ADAS	Advanced Driver Assistance Systems
AF	Antenna Factor
AI	Artificial Intelligence
ANSI	American National Standardization Institute
AP	Access Point
AV	Average
CENELEC	European Committee for Electrotechnical Standardization
CFR	Code of Federal Regulations
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
C-V2X	Cellular Vehicle to Everything
EM	Electromagnetic
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	European Norm
EUT	Equipment Under Test
FAR	Full Anechoic Room
FSOATS	Free Space Open Area Test Site
G.Fast	Type of Digital Subscriber Line
GPS	Global Positioning System
GRP	Ground Reference Plane
ICES	Interference-Causing Equipment Standard
ICT	Information and Communication Technology
IF	Intermediate Frequency
IMT	International Mobile Technology
LTE	Long Term Evolution
MME	Multi Media Equipment
NR	New Radio
OLT	Optical Line Terminal
PK	Peak
RBW	Resolution Bandwidth
RF	Radio Frequency
RVC	Reverberation Chamber
TDB	To Be Defined
TNE	Telecommunications Network Equipment
UE	User Equipment
VSWR	Voltage Standing Wave Ratio

4 Rationale

4.1 Background

With the need for faster digital communications, and higher bandwidths, today's internet technologies have to use Gigabit per second (Gbps) signals within TNE to satisfy the growing demand. The implications for equipment to enable these faster digital communications include:

- High speed clocks and data on internal PCBs, processors and ASICs.
- Extensive use of high speed optical modules, placed at the periphery of the equipment, which may have emissions at key frequencies (for example 10 GHz and 26 GHz).
- Extremely high capacity backplanes to support the numerous required interfaces, cards and the high volume of traffic.
- Unintentional emissions at frequencies above 6 GHz.

Meanwhile, from the perspective of wireless communications, the radio technology has been developing rapidly with AI services based on 4G LTE and 5G NR, with use cases such as the smart home, smart city and autonomous driving. These radio services are rapidly expanding and using the higher frequency spectrum above 6 GHz.

Hence the impact of the unintentional emissions may reduce the effectiveness of the radio services.

4.2 Risk scenarios for high frequency EMI

Three typical scenarios are outlined:

- Radiation disturbance from telecommunication centres (supporting cloud web services) to radio base station(s), Figure 1.
- Radiation disturbance from data access equipment in city streets to vehicles, UE, and radio base stations, Figure 2.
- Radiation disturbance between electronics in the home environment, Figure 3.

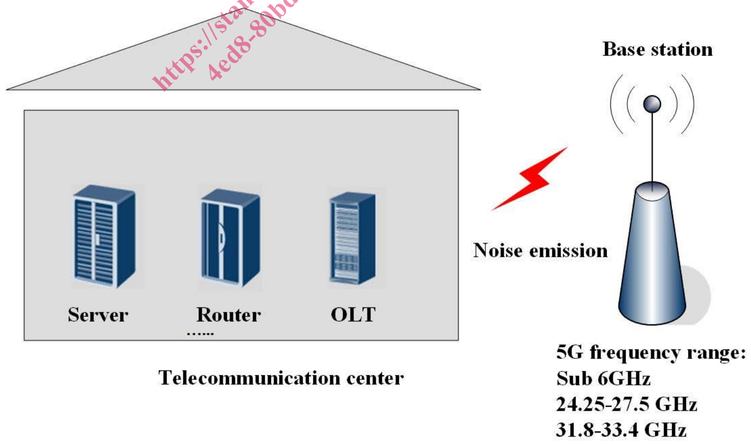

Figure 1: Disturbance from telecommunication to base station system

Figure 2: Disturbance to vehicles and base stations due to outside access equipment on the street

Figure 3: Disturbance to wireless systems in the home

5 Radiated emission limits

5.1 Overview of existing limits

CISPR, the international committee responsible for the establishing limits and methods to protect radio services, is at the very early stages of developing radiated electric field emission limits above 6 GHz, so the current proposal uses a combination of the requirements within the following standards to establish an interim solution:

- CFR Title 47 Part 15 [5]
- ANSI C63.2 [4]
- ANSI C63.4 [8]
- EN 55032 [1]
- ETSI EN 300 386 [10]
- CISPR 16 series [2], [3], [7], [9], [11], and [i.6]