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HARMONISED EUROPEAN STANDARD

ElectroMagnetic Compatibility (EMC) standard for radio equipment and services;
Part 9: Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio, in-ear monitoring and assistive listening devices;
Harmonised Standards for ElectroMagnetic Compatibility

Reference
REN/ERM-EMC-425

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Foreword

This draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI Standardisation Request deliverable Approval Procedure (SRdAP).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.3] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

The present document is part 9 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

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.

1 Scope

The present document specifies technical characteristics and methods of measurements for wireless microphones, similar RF audio link equipment, cordless audio (including low power Band II transmitters), in-ear monitoring, cochlear implant and assistive listening devices, intended for the transmission of music and speech including the associated ancillary equipment in respect of electromagnetic compatibility, as detailed in table 1.

Technical specifications related to the antenna port and emissions from the enclosure port of the radio equipment are out of scope of the present document. Such technical specifications are found in the relevant product standards for the effective use of the radio spectrum, see table 1.

The present document specifies the applicable test conditions, performance assessment and performance criteria for wireless microphones, similar RF audio link equipment, cordless audio, in-ear monitoring, ALD and Cochlear Implants and associated ancillary equipment. This equipment can use analogue or digital modulation techniques.

Low quality speech applications as toy microphones, baby phones etc. operating at frequencies below 50 MHz, occupied bandwidth < 25 kHz and operating according to CEPT/ERC/REC 70-03 [i.2], Annex 1 are out of scope of the present document.

Table 1: Radio Technologies in scope of the present document

Technology	ETSI Standard
Wireless Microphones In-Ear Monitoring Wireless Multichannel Audio Systems	ETSI EN 300 422-1 [2]
Assistive Listening Devices Cochlear Implants Neck loops-T-Coil Personal Sound Amplifiers Hearing Aid Systems	ETSI EN 300 422-4 [i.13]
Cordless Audio Low Power FM Tx low Power Radio Microphones In-Ear Monitoring	ETSI EN 301 357-1 [i.12]
Audio Links	ETSI EN 300 454-1 [i.11]

For cochlear implants more stringent EMC standards exist and Annex E provides information on its relationship to the present document.

NOTE 1: Technical specifications related to conducted emission EMC requirements below 9 kHz on the AC mains port of radio equipment are out of scope of the present document. Such technical specifications are normally found in the relevant product family standards for AC mains powered equipment (e.g. EN 61000-3-2 [i.6] and EN 61000-3-3 [i.7]).

NOTE 2: The relationship between the present document and essential requirements of article 3.1(b) of Directive 2014/53/EU [i.1] is given in Annex A.

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 in the ETSI docbox.

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] ETSI EN 301 489-1 (V2.2.3) (11-2019): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility".

[2] ETSI EN 300 422-1 (V2.2.1) (11-2021): "Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum".

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 may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

[i.2] CEPT/ERC/REC 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.3] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.4] Void.

[i.5] Void.

[i.6] IEC EN 61000-3-2 (2014): "Electromagnetic compatibility (EMC) - Part 3-2: Limits -Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)".

[i.7] IEC EN 61000-3-3 (2013): "Electromagnetic compatibility (EMC) - Part 3-3: Limits -Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection".

[i.8] EN 45502-2-3 (2010): "Active implantable medical devices - Part 2-3: Particular requirements for cochlear and auditory brainstem implant systems" (Produced by CENELEC).

[i.9] EN 60601-1-2 (2015) + A1(2021): "Medical electrical equipment-General requirements for basic safety and essential performance. Collateral Standard: Electromagnetic disturbances. Requirements and tests" (Produced by CENELEC).

[i.10] Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices, amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 and repealing Council Directives 90/385/EEC and 93/42/EEC.

[i.11] ETSI EN 300 454-1 (V1.1.2) (08-2000): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Wide band audio links; Part 1: Technical characteristics and test methods".

[i.12] ETSI EN 301 357-1 (V1.4.1) (11-2008): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Cordless audio devices in the range 25 MHz to 2 000 MHz; Part 1: Technical characteristics and test methods".

[i.13] ETSI EN 300 422-4 (V2.1.1) (05-2017): "Wireless Microphones; Audio PMSE up to 3 GHz; Part 4: Assistive Listening Devices including personal sound amplifiers and inductive systems up to 3 GHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 301 489-1 [1] and the following apply:

Assistive Listening Device (ALD) for hearing impaired: aid for a hearing-impaired person, also known as a hearing aid

Assistive Listening System (ALS) for hearing impaired: systems utilizing electromagnetic, radio or light waves, or a combination of these, to transmit the acoustic signal from the source (e.g. a loudspeaker or a person talking) directly to the hearing-impaired person

NOTE: Both aids for the hearing impaired and Assistive Listening devices would normally be prescribed by a hearing professional.

Audio-Frequency Induction-Loop System (AFILS): system including induction loop amplifier(s), microphones and/or other signal sources, in which magnetic fields are created by the flow of audio-frequency current in a conductor arranged in the form of a loop or coil

Cochlear Implant (CI): surgically implanted neuroprosthetic device intended to provide a person with moderate to profound sensorineural hearing loss a modified sense of sound

NOTE: CI bypasses the normal acoustic hearing process to replace it with electric signals which directly stimulate the auditory nerve.

Cochlear Implants (CI) transformer coils: two transformer windings separated by the human skin

NOTE: For the purpose of the present document the CI transformer coils of a conventional CI are using magnetic induction for providing power and data to the implant from the external sound processor/hearing aid and not to recharge the CI by WPT.

companding: method of audio processing that compresses the audio dynamic range before transmission and then provides matching expansion of the signal in the receiver

NOTE: The method is used to improve the audio performance in the RF link.

hearing aid system: broadcast radio communication system comprising one transmitter (up to 500 mW in the band 169,4 MHz to 169,8125 MHz), which is installed at a fixed location in a large auditorium.

EXAMPLE: In a church or theatre and one or more receivers, where each receiver can have wired or inductive connection to a hearing aid

In Ear Monitor (IEM): body worn miniature receiver with earpieces for personal monitoring of single- or dual-channel sound

integral antenna: antenna designed to be connected to the equipment without the use of a 50 Ω external connector and considered to be part of the equipment

NOTE: An integral antenna may be fitted internally or externally to the equipment.

low power band 2 transmitters: band II LPD (low power devices) up to 200 kHz bandwidth and analogue modulation

mobile equipment: receiver, transmitter or transmitter/receiver (transceiver) intended for installation and use in a vehicle, and powered by the main battery of the vehicle

neck loop: insulated wire loop antenna which goes around the neck connecting to a small unit and communicates with the T-coil receiver contained within a hearing aid, ALD or Cochlear implant

personal hearing aid system: radio communication system comprising of a transmitter, which can be handheld, on a table or around the neck of a hearing-impaired person and one or more receivers, where each receiver can have wired or inductive connection to a hearing aid

personal sound amplifier: body-worn device providing sound amplification

radio microphone: microphone combined with a radio transmitter as a handheld or bodypack device; sometimes referred to as wireless microphone

switching range: maximum frequency range over which the receiver or transmitter can be operated without reprogramming or realignment

T-Coil: small wire coiled around a rod located inside the hearing aids, works as an antenna to pick up magnetic signals and streams them as sound into the hearing aids

vehicle power supply: battery used for the primary operation of the vehicle, i.e. the ignition or starting of the vehicle

Wireless Multichannel Audio Systems (WMAS): wireless audio transmission systems using digital broadband transmission techniques for microphone and in-ear monitor system applications, and other multichannel audio PMSE use, e.g. with the ability to support three or more audio channels per MHz

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 301 489-1 [1] and the following apply:

AFILS	Audio-Frequency Induction-Loop System
ALD	Assistive Listening Device
ALS	Assistive Listening System
CI	Cochlear Implant
CR	Continuous phenomena applied to Receivers
CT	Continuous phenomena applied to Transmitters
e.r.p.	effective radiated power
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
IEM	In-Ear Monitoring
LPD	Low Power Device
PMR	Professional Mobile Radio
RF	Radio Frequency
SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
TR	Transient phenomena applied to Receivers
TT	Transient phenomena applied to Transmitters
WMAS	Wireless Multichannel Audio Systems
WPT	Wireless Power Transmission

4 Test conditions

4.1 Applicability

For the purposes of the present document, the test conditions of ETSI EN 301 489-1 [1], clause 4 shall apply except where modified in clauses 4.2 to 4.6.

4.2 General

For emission and immunity tests the test modulation, test arrangements, etc., as specified in the present document, clauses 4.2 to 4.6 shall apply.

For the purpose of EMC tests, body-worn or handheld transmitters shall be mounted on a non-conductive stand at least 0,8 m from any conducting surface. The EUT and any other equipment required for the performance assessment before, during, and after the conclusion of the tests, shall be connected according to the intended use.

Whenever the EUT is provided with a detachable antenna, it shall be tested with the antenna fitted according to the intended use.

For immunity tests, if the equipment is of a category which permits it, a communications link shall be established at the start of the test and maintained during the test.

The test conditions shall be as follows:

- the transmitter shall be operated at its normal maximum RF output power modulated with a suitable modulation signal (see clause 4.6.2);
- for standalone receivers or receivers of transceivers operating in simplex mode, the wanted RF input signal, coupled to the receiver, shall be modulated with a suitable modulation signal (see clause 4.6.3);
- for duplex transceivers, the wanted RF input signal, coupled to the receiver, shall be modulated with a suitable modulation signal (see clause 4.6.3). The transmitter shall be operated at its normal maximum output power, modulated with the test modulation signal, coupled to the transmitter from the output of the receiver (repeater mode);
- digitally modulated systems shall use a defined interface to convert between analogue and digital domain (and vice versa).

4.3 Arrangements for test signals

4.3.1 General

The provisions of ETSI EN 301 489-1 [1], clause 4.2 shall apply.

4.3.2 Arrangements for test signals at the input of transmitters

The provisions of Annex B and of ETSI EN 301 489-1 [1], clause 4.2.1 shall apply with the following modifications.

For transmitters designed to operate from an integral or dedicated microphone (see figure 2), an acoustic coupling device shall be used to inject the normal test modulation signal (see figure 3).

The transmitter shall be tested at its most sensitive input.

For equipment not designed to use an integral or dedicated microphone, the test signal shall be fed in electrical form to the most sensitive input socket (see figure 1) using maximum length cables as normally supplied with the equipment.

The modulation signal used for the tests shall be a 1 kHz sine wave tone at a level expected to obtain 100 % audio modulation.

In the case of systems with a digital audio input and outputs this test signal shall be presented via a suitable test fixture converting the analogue signal to the digital domain and vice-versa.

4.3.3 Arrangements for test signals at the output of transmitters

The provisions of ETSI EN 301 489-1 [1], clause 4.2.2 shall apply.

4.3.4 Arrangements for test signals at the input of receivers

The provisions of ETSI EN 301 489-1 [1], clause 4.2.3 shall apply with the following modifications.

The wanted RF input signal to the receiver should be modulated with a suitable signal corresponding to 100 % audio modulation (maximum channel loading). If it is not appropriate to provide a modulated RF signal to the receiver, the test may be performed using an unmodulated wanted RF input signal.

For analogue radio microphones the level of the wanted RF input signal shall be set to a value 60 dB above the threshold sensitivity of the receiver. Where a transmitter is used to setup a communication link, an attenuator in the EUT input may be necessary.

For digital microphone receivers, tested either with an RF generator or in a system setup with a microphone transmitter, the maximum rated RF output power of the transmitter shall be used to establish a stable communication link during emission and immunity testing, but this level shall not exceed 50 mW e.r.p., which is the maximum allowed RF output power defined in ETSI EN 300 422-1 [2], clause 4.2.1.2.

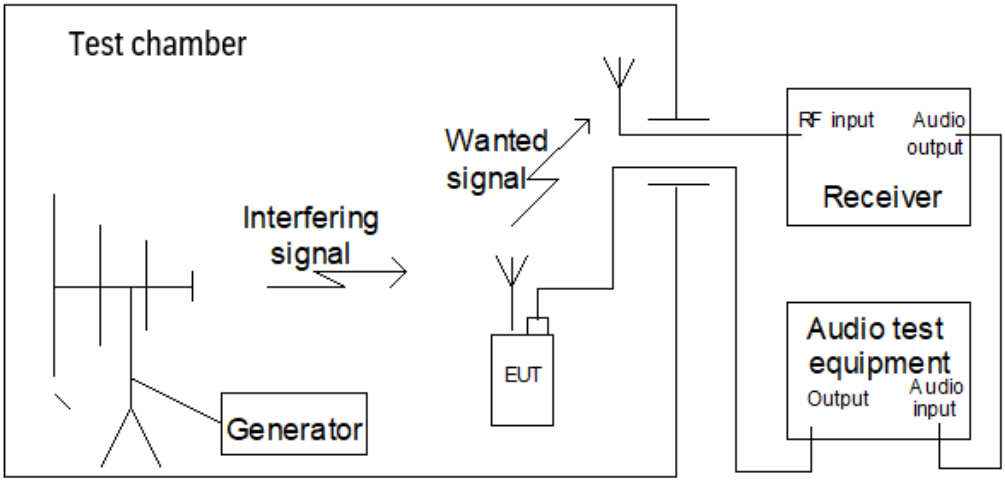


Figure 1: Test configuration for integral antenna; transmitter operation - electrical input

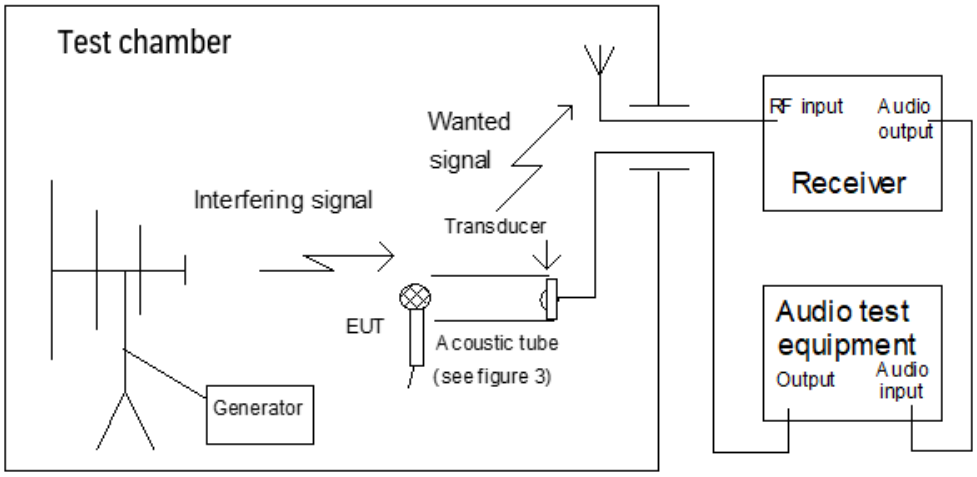


Figure 2: Test configuration for integral antenna; transmitter operation - acoustic input

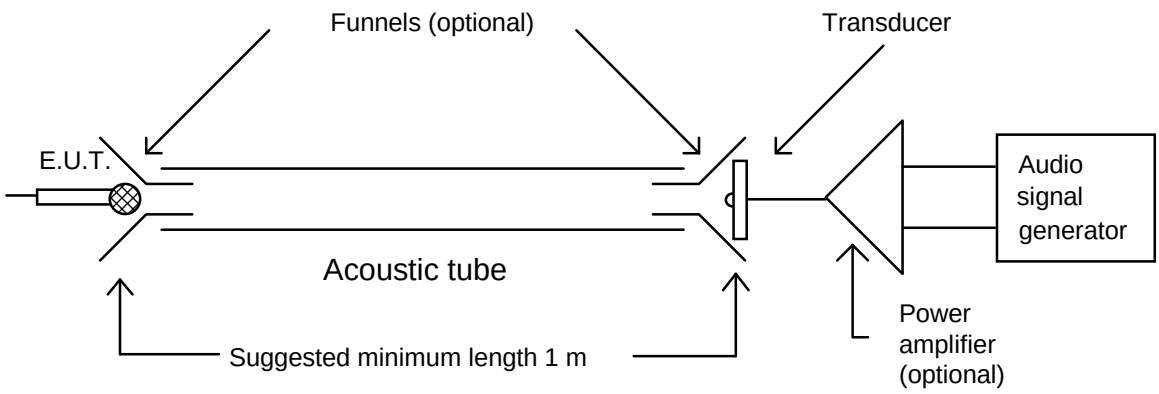
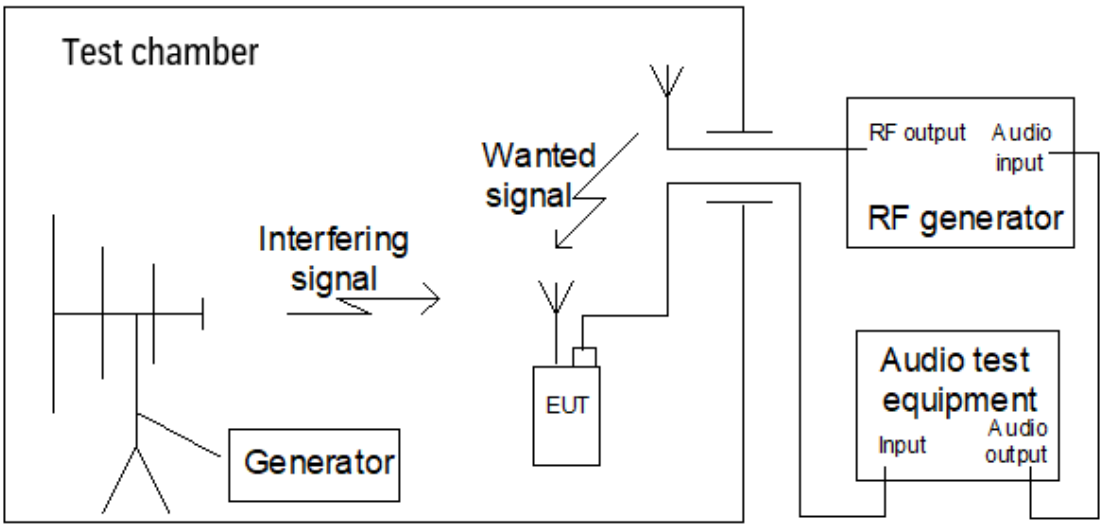


Figure 3: Example of acoustic coupling jig



NOTE: The RF generator can be a companion transmitter sited inside the test chamber, if necessary.

Figure 4: Test configuration for integral antenna; receiver operation

4.3.5 Arrangements for test signals at the output of receivers

The provisions of ETSI EN 301 489-1 [1], clause 4.2.4 shall apply with the following modification.

The audio frequency output of the equipment shall be coupled to the SINAD measuring system outside of the test environment.

The characteristics of the SINAD measuring system should be such that the upper -3 dB frequency of its detector part is to exceed 16 kHz, and its electrical measurement flatness error between 40 Hz and 16 kHz is not to exceed ±2 dB.

In the case of systems with a digital audio output, a test fixture to convert from digital to analogue signals shall be used.

4.3.6 Arrangements for testing transmitter and receiver together (as a system)

In case of digitally modulated systems, test fixtures for converting from the analogue to the digital domain and vice versa shall be used.

4.4 Exclusion bands

4.4.1 General

The provisions of ETSI EN 301 489-1 [1], clause 4.3 shall apply.

4.4.2 Receiver and receivers of transceivers exclusion band

The exclusion band for receivers and receivers of transceivers is the frequency range determined by the switching range, extended as follows:

1) Category 1 and 2 equipment (as defined in clause 6):

   - the lower frequency of the exclusion band is the lower frequency of the switching range, minus 5 % of the centre frequency of the switching range;

   - the upper frequency of the exclusion band is the upper frequency of the switching range, plus 5 % of the centre frequency of the switching range.

2) Category 3 equipment (as defined in clause 6):

   - the lower frequency of the exclusion band is the lower frequency of the switching range, minus 5 % of the centre frequency of the switching range, or minus 10 MHz, whichever will result in the lowest frequency;

   - the upper frequency of the exclusion band is the upper frequency of the switching range, plus 5 % of the centre frequency of the switching range, or plus 10 MHz, whichever will result in the highest frequency.

The category of equipment shall be determined according to clause 6 of the present document before testing.

4.4.3 Transmitter exclusion band

The lower frequency of the exclusion band is the lower frequency of the switching range, minus 5 % of the centre frequency of the switching range.

The upper frequency of the exclusion band is the upper frequency of the switching range, plus 5 % of the centre frequency of the switching range.

4.5 Intermediate frequency responses of receivers

Responses on receivers occurring during the immunity tests at discrete frequencies which are intermediate frequency responses (spurious responses), are identified by the following method.

If during the test the immunity RF test signal causes non-compliance of the receiver with the specified performance criteria (see clause 6), it is necessary to evaluate whether this non-compliance is due to an intermediate frequency response or a wideband phenomenon.

Therefore, the frequency of the test signal is increased by an amount equal to twice the nominal 6 dB bandwidth of the IF filter immediately preceding the demodulator of the receiver, or the bandwidth over which the equipment is intended to operate. The test is repeated with the frequency of the test signal decreased by the same amount. If the receiver is then in either or both frequency offset cases in compliance with the specified performance criteria, the response is considered as an intermediate frequency response. If the receiver still does not comply with the specified performance criteria, this can be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another intermediate frequency response. Under these circumstances the procedure is repeated with an increase and decrease of the frequency of the test signal adjusted two and a half times the bandwidth referred to above.

If the receiver still does not comply with the specified performance criteria in either or both frequency offset cases, the phenomena is considered wide band and therefore an EMC problem and the equipment fails the test.

For immunity tests, intermediate frequency responses shall be disregarded.

4.6 Normal test modulation

4.6.1 Void

4.6.2 Transmitters

The transmitter shall be modulated with a sinusoidal audio frequency signal of 1 000 Hz, provided either by an acoustic coupling means or by a shielded transmission line (e.g. a coaxial cable). The level of this audio signal shall be adjusted corresponding to 100 % audio modulation (maximum channel loading) of the wanted RF carrier.

For digitally modulated systems, a test fixture to allow for testing equivalent to 100 % audio modulation level shall be used.

4.6.3 Receivers

The receiver's wanted RF input signal shall be set to the operation frequency of the receiver within the designated operation frequency band and modulated with a sinusoidal audio frequency of 1 000 Hz, provided either by a test antenna located within the test environment (integral antenna receivers) or a shielded transmission line such as a coaxial cable (non-integral antenna receivers). The level of the modulation signal shall be adjusted resulting in 100 % audio modulation (maximum channel loading) of the receivers wanted RF input signal.

For digitally modulated systems, a test fixture to allow for testing equivalent to 100 % audio modulation level shall be used.

5 Performance assessment

5.1 General

At the time of submission of the equipment for test, the parameters of the intended use and other important testing details not described in the present document should be recorded in the test report (see informative Annex D of the present document).

5.2 Ancillary equipment

Ancillary equipment shall be tested and assessed by applying the provisions of the present document in either of the following methods:

- Separately to the ancillary equipment with the radio equipment outside of the measurement area but still connected to the ancillary equipment. This is used where according to the intended use of the equipment, the ancillary equipment can be more than 2m from the radio equipment.
- Otherwise, the combination of ancillary equipment and radio equipment shall be both within the measurement area.

If the first option above is chosen, then no exclusion bands shall be applied to the ancillary equipment.

5.3 Assessment procedures

The performance assessment shall be based upon:

- maintaining the function(s);
- the way the eventual loss of function(s) can be recovered;
- unintentional behaviour of the EUT.

The test system shall set up a communications link in the same manner as the Equipment Under Test's (EUT) intended use.

The assessment procedure shall verify that the communications link is maintained and that there is no loss of user control functions or loss of critical stored data.

Where the EUT is capable of operation in multiple frequency bands, each band shall be subject to assessment.

Where the EUT is capable of operating in multiple radio technologies, the operation of each technology shall be assessed.

Where the EUT is a transmitter able to operate with different capsules, the most sensitive capsule shall be tested as the representative capsule and be subject to the assessment.

6 Performance criteria

6.1 Introduction

6.1.1 General

The product family of wireless microphones and similar RF audio link equipment identified in table 1 and associated ancillary equipment is divided into three categories of equipment, each having its own set of performance criteria:

- **Category 1 equipment** comprises wireless microphones, similar RF audio link equipment, and associated ancillary equipment intended for **professional applications**.
- **Category 2 equipment** comprises consumer wireless microphones, cordless audio devices, in-ear monitoring devices and associated ancillary equipment intended for **domestic entertainment**.
- **Category 3 equipment** comprises consumer wireless microphones, cordless audio, wireless headphones and associated ancillary equipment intended for **general consumer purposes**.

The establishment of the communication link at the start of the test, its maintenance and the assessment of the recovered signal (e.g. audio output) are used as the performance criteria for the evaluation of the essential functions of the equipment during and after the test.

The performance criteria A, B and C set out in table 2 shall be used in the following manner:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria C for immunity tests with power interruptions and voltage dips exceeding a certain period of time.

6.1.2 General performance criteria

The equipment shall meet the performance criteria specified in table 2, as detailed in the special performance criteria in clause 6.2.

Table 2: General performance criteria

During test	After test	Criteria
Operate as intended; Degradation of performance (see note 1); No loss of function.	Operate as intended; No degradation of performance (see note 2); No loss of function.	A
Loss of function (one or more).	Operate as intended; No degradation of performance (see note 2); Functions self-recoverable.	B

During test	After test	Criteria
Loss of function (one or more).	Operate as intended; No degradation of performance (see note 2); Functions recoverable by the operator.	C

NOTE 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level for the use of the apparatus as intended. In some cases the minimum performance level may be replaced by a permissible degradation of performance.
The permissible degradation of performance may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: No degradation of performance after the test is understood as no degradation below a minimum performance level for the use of the apparatus as intended. In some cases the minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.
The minimum performance level or the permissible degradation of performance may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

6.2 Performance Requirements

6.2.1 Performance criteria for equipment which provides a continuous communication link

6.2.1.1 General

The establishment of the communications link at the start of the test, the maintenance of the communications link and the assessment of the recovered signal information, e.g. an audio signal, shall be used as the performance criteria to ensure that the essential functions of the transmitter and/or receiver are evaluated during and after the test.

The equipment shall meet the minimum performance criteria as specified for the appropriate category of equipment in clause 6.1.2.

6.2.1.2 Performance criteria for Continuous phenomena applied to Transmitters (CT) and Receivers (CR)

The following performance criteria for continuous phenomena apply for transmitters (CT) and receivers or receiver parts of simplex or duplex transceivers (CR) permitting the establishment of a continuous communications link:

- before the test it shall be verified that the EUT, when coupled through the test equipment and not subjected to EMC stress is capable of producing a SINAD figure of at least 3 dB above the category limit specified in table 3;
- during each individual exposure in the test sequence it shall be verified that the communications link is maintained;
- at the conclusion of the test the EUT shall operate as intended with no loss of user control functions or critical stored data, and the communications link shall have been maintained during the test.

During and after the tests the audio output shall be monitored and assessed. During the test, the SINAD of the audio output shall not result in levels below the relevant category limit specified in table 3. After the test, the SINAD shall recover to that level recorded before the test or at least to levels not below the relevant category limit specified in table 3.

Table 3: Continuous phenomena, minimum performance criteria

Equipment category	Minimum performance criterion
Category 1	30 dB SINAD
Category 2	20 dB SINAD
Category 3	6 dB SINAD

Where the EUT is a transmitter only, and a stand-by mode of operation is provided, the tests shall be repeated with the EUT in stand-by mode of operation to ensure that unintentional transmission does not occur.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

6.2.1.3 Performance criteria for Transient phenomena applied to Transmitters (TT) and Receivers (TR)

The following performance criteria for transient phenomena apply for transmitters (TT) and receivers or receiver parts of simplex or duplex transceivers (TR) permitting the establishment of a continuous communications link:

- before the test it shall be verified that the EUT, when coupled through the test equipment and not subjected to EMC stress is capable of producing a SINAD figure of at least 3 dB above the category limit specified in table 3;
- at the conclusion of each exposure in the test sequence the EUT shall operate with no user noticeable loss of the communications link;
- at the conclusion of the total test comprising of a series of individual exposures the EUT shall operate as intended with no loss of user control functions or critical stored data, and the communications link shall have been maintained during the test.

After the tests the audio output shall be monitored and assessed. After the test the SINAD shall recover to that level recorded before the test or at least to levels not below the relevant category limit specified in table 3.

Where the EUT is a transmitter only, and a stand-by mode of operation is provided, the tests shall be repeated with the EUT in stand-by mode of operation to ensure that unintentional transmission does not occur.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

6.2.2 Performance criteria for equipment which does not provide a continuous communication link

For immunity tests with continuous phenomena, equipment not permitting the establishment of a continuous communications link and ancillary equipment intended to be tested on a stand-alone basis shall meet the following performance criteria:

- performance criteria A for category 1 equipment;
- performance criteria C for categories 2 and 3 equipment;

as specified in table 2.

For immunity tests with transient phenomena, equipment not permitting the establishment of a continuous communications link and ancillary equipment intended to be tested on a stand-alone basis shall meet the performance criteria B as given in table 2, except for immunity tests with voltage dips and interruptions (see ETSI EN 301 489-1 [1], clause 9.7), where it is explicitly stated that the communications link need not be maintained in which case performance criteria C from table 2 shall apply.

7 Technical requirements overview

7.0 General requirements

The environmental classification and the emission and immunity requirements used in the present document are as stated in ETSI EN 301 489-1 [1], except for any special conditions included in the present document.

7.1 Emission

7.1.1 General

The emission requirements set out in table 4 shall apply.

The EUT test configuration shall be in accordance with ETSI EN 301 489-1 [1], clause 8.1.2.

Cochlear implants can demonstrate compliance with the requirements in table 4, if it fulfils the more stringent requirements of the Medical Device Regulation (EU) 2017/745 [i.10].

NOTE: Further information is provided in Annex E.

Table 4: Emission requirements

Phenomenon	Port	Applicability				Reference clause
		Fixed equipment	Vehicular equipment	Portable equipment	Cochlear Implants	
radiated emission	enclosure of ancillary equipment	applicable	applicable	applicable	see note	ETSI EN 301 489-1 [1], clause 8.2
conducted emission	DC power input/output	applicable	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.3
conducted emission	AC mains input/output	applicable	not applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.4
conducted emission	signal, wired network and control	applicable	not applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.7
NOTE: Applicable, if ancillary equipment is not covered by Medical Device Regulation (EU) 2017/745 [i.10].						

Portable equipment, or combinations of equipment, capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as vehicular equipment.

Portable or vehicular equipment, or combinations of equipment, capable of being powered for intended use by AC mains shall additionally be considered as fixed equipment.

7.1.2 Special conditions

The following special conditions set out in table 5, relate to the emission test methods used in ETSI EN 301 489-1 [1], clause 8 and shall apply.

Table 5: Special conditions for EMC emission measurements

Reference to clauses in ETSI EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in ETSI EN 301 489-1 [1], clause 8
8.1 Test configuration; Methods of measurement and limits for EMC emissions	The radio equipment shall be operated on one channel frequency, which is close to the middle of the switching range. In transmit mode of operation, the transmitter shall be operated to obtain its maximum rated RF power.

7.2 Immunity

7.2.1 General

The immunity requirements set out in table 6 shall apply.

Cochlear implants demonstrate compliance with the requirements in table 6, if they fulfil the more stringent requirements of the Medical Device Regulation (EU) 2017/745 [i.10].

NOTE: Further information is provided in Annex E.

Table 6: Immunity test requirements

Phenomenon	Port	Applicability				Reference clause	Performance Criteria clauses (see note 4)
		Fixed equipment	Vehicular equipment	Portable equipment	Cochlear Implants		
RF electro-magnetic field (80 MHz to 6 000 MHz)	Enclosure	applicable	applicable	applicable	see note 3	ETSI EN 301 489-1 [1], clauses 9.2.1 and 9.2.2	6.2.1.2 or 6.2.2
electrostatic discharge	Enclosure	applicable	applicable	applicable	see note 3	ETSI EN 301 489-1 [1], clauses 9.3.1 and 9.3.2	6.2.1.3 or 6.2.2
fast transients common mode	Signal, wired network and control	applicable	not applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.4.1 and 9.4.2	6.2.1.3 or 6.2.2
	DC power	applicable	not applicable (see note 1)	not applicable	not applicable		6.2.1.3 or 6.2.2
	AC mains power	applicable	not applicable	not applicable	not applicable		6.2.1.3 or 6.2.2
RF common mode 0,15 MHz to 80 MHz	Signal, wired network and control	applicable	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.5.1 and 9.5.2	6.2.1.2 or 6.2.2
	DC power	applicable	applicable	not applicable	not applicable		6.2.1.2 or 6.2.2
	AC mains power	applicable	applicable	not applicable	not applicable		6.2.1.2 or 6.2.2
transients and surges in Vehicular environment	DC power input	not applicable	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.6.1 and 9.6.2	6.2.1.3 (see note 2) or 6.2.2
voltage dips and interruptions	AC mains power input	applicable	not applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.7.1 and 9.7.2	6.2.1.3 or 6.2.2
surges, line to line and line to ground	AC mains power input	applicable	not applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.8.1 and 9.8.2	6.2.1.3 or 6.2.2
	Wired network	applicable	not applicable (see note 1)	not applicable	not applicable		6.2.1.3 or 6.2.2

NOTE 1: This requirement is covered by the transients and surges test on DC power input ports.
NOTE 2: For pulses 3a & 3b, the performance criteria for continuous phenomena shall apply (see ETSI EN 301 489-1 [1], clause 6.2).
NOTE 3: Applicable, if equipment is not covered by Medical Device Regulation (EU) 2017/745 [i.10].
NOTE 4: Selection of performance criteria is dependent upon device transmission type.

Portable equipment, or combinations of equipment, capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as vehicular equipment. Portable or vehicular equipment, or combinations of equipment, capable of being powered for intended use by AC mains shall additionally be considered as fixed equipment.

7.2.2 Special conditions

The following special conditions set out in table 7, relate to the immunity test methods and performance criteria used in ETSI EN 301 489-1 [1], clause 9 and shall apply.

Table 7: Special conditions for EMC immunity tests

Reference to clauses in ETSI EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in ETSI EN 301 489-1 [1], clause 9
9.1 Test configuration; Test methods and levels for immunity tests	For immunity tests of transmitters, the transmitter shall be operated at its maximum rated RF output power. The immunity tests shall be performed with the EUT successively set to all modes of operation available for the EUT.

Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.3] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table A.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 301 489-9					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Emissions: Enclosure of ancillary equipment measured on a standalone basis	3.1(b)	7.1.1	C	Only applicable to ancillary equipment not incorporated in the radio equipment
2	Emissions: DC power input/output ports	3.1(b)	7.1.1	C	Only where equipment has DC power input and/or output ports capable of being used with cables greater than 3 m or from a vehicle power supply
3	Emissions: AC mains power input/output ports	3.1(b)	7.1.1	C	Only where equipment has AC mains power input and/or output ports
4	Emissions: Wired network ports	3.1(b)	7.1.1	C	Only where equipment has wired network ports
5	Immunity: Radio frequency electromagnetic field (80 MHz to 6 000 MHz)	3.1(b)	7.2.1	U	
6	Immunity: Electrostatic discharge	3.1(b)	7.2.1	U	
7	Immunity: Fast transients common mode	3.1(b)	7.2.1	C	Only where equipment has AC mains power input ports or other ports capable of being used with cables longer than 3 m
8	Immunity: Radio frequency common mode	3.1(b)	7.2.1	C	Only where equipment has AC mains power input ports or other ports capable of being used with cables longer than 3 m
9	Immunity: Transients and surges in the vehicular environment	3.1(b)	7.2.1	C	Only where equipment is connected to vehicle power supply
10	Immunity: Voltage dips and interruptions	3.1(b)	7.2.1	C	Only where equipment has AC mains power input ports

Harmonised Standard ETSI EN 301 489-9					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
11	Immunity: Surges, line to line and line to ground	3.1(b)	7.2.1	C	Only where equipment has AC mains power input ports

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (normative): Acoustic stimulation of wireless radio microphones and similar radio communications link equipment, conditions for the test set up and configuration.

B.1 General

This annex defines the methods of stimulating the EUT when carrying out the necessary EMC tests specified in the present document, in recognition of the rather unusual nature of radio microphones, as compared with the generality of radio products.

Radio microphones vary enormously in their sensitivity and acoustic directivity.

In testing wireless radio microphones, it should be borne in mind that many products employ companding techniques.

B.2 Audio excitation

As part of the EMC test sequence specified in the present document it is necessary to provide an audio excitation signal to the microphone transducer. The method applied to achieve this is dependent on the physical characteristics of the EUT and examples of such methods are found below, noting that the selection of the method does not impact the pass/fail criteria of the tests:

1) by means of an electro-acoustic resonator (in order to avoid distortion of the calibrated field, this shall be placed outside the physical area of calibration, and be non-metallic); or

2) by means of an acoustic tube (this may be rigid or flexible, but shall have an acoustically "hard" wall, be of non-conducting material, and be of constant inner diameter throughout its length).

The driver transducer shall be large enough, and excited strongly enough, to be able to deliver sufficient sound pressure at the microphone to fully excite the EUT's modulator. Overdrive shall however be avoided.

The driver transducer shall be placed well away from the EUT's microphone, (because it will ordinarily be a moving coil magnetic type), in order to avoid inter-transducer magnetic coupling, and in order to avoid distortion of the electromagnetic test field.

Coupling to the driver transducer, and to the EUT's microphone transducer, may be by means of funnels or other appropriate means. The attachments shall be fixed and firm throughout the test sequence.

When the transducer is coupled to the EUT by means of an acoustic tube, bends in the tube shall be avoided or minimized. Any bends in the tube shall always have a radius that is large in relation to the inner diameter of the tube. Standing waves in the tube may be overcome by lightly packed cotton wool damping pads placed at 150 mm intervals along the length of the tube. It is recommended that the driver transducer is located inside the test chamber, thus minimizing the length of the tube.

NOTE: In trials of this test method a tube length of 1 m has been successfully used. The tube was 12,5 mm bore plastic reinforced water hose. The driver transducer was a 75 mm car radio speaker, with a large ferrite magnet, capable of cone movement exceeding 10 mm peak-to-peak. The driver was coupled into the pipe by means of a domestic plastic funnel.

Annex C: Void

Annex D (informative): Minimum test report information

D.1 Introduction

This annex defines minimum information to be provided to the test laboratory for inclusion into the test report to increase the testing reproducibility.

D.2 Information to be provided before testing

D.2.1 Test fixture and audio interface description applied for testing

For systems with digital audio inputs and/or digital audio outputs where a test fixture to convert signals from digital to analogue and vice versa is used (as described in clause 4.3 of the present document), details on the test fixture and audio interface should be provided in the test report.

D.2.2 Coupling means applied for testing

The coupling means used for the application of the modulation signal to the EUT and for monitoring the output of the EUT should be detailed in the test report.

D.2.3 Receiver category applied for testing

The receiver category according to clause 6 of the present document should be recorded in the test report.

D.2.4 Switching range of the product

To determine the exclusion band according to clause 4.4 of the present document, the switching range applied for the exclusion band should be recorded in the test report.

D.2.5 Test modulation for communication link

For digitally modulated systems using a test fixture for testing equivalent to 100 % audio modulation, the modulation method and its parameters should be recorded in the test report.

D.2.6 Test signal for communication link

The level and makeup of the RF test signal and additional equipment used for establishing the communications link should be recorded in the test report.

Annex E (informative): Cochlear Implants - EMC Requirement Comparison

E.1 Introduction

Annex E shows the relationship between the requirements for Cochlear Implants in the present document and their equivalents in EN 45502-2-3 [i.8] and EN 60601-1-2 [i.9] used under the Medical Device Regulation (EU) 2017/745 [i.10].

Following a request from the European Commission Radio Experts Group, WGFM requested SRDMG to consider the issue of medical devices' compliance with the spectrum access requirements of the Radio Equipment Directive 2014/53/EU [i.1] and concluded that EMC testing of wireless medical devices under the Medical Device Regulation (EU) 2017/745 [i.10] is sufficient to show compliance for EMC purposes and thus avoiding double testing.

Examination of the EMC standards required by the Medical Device Regulation (EU) 2017/745 [i.10] (require third party testing and Notified Body assessment) identified in table E.1 of the present document shows that the EMC testing of medical devices is more stringent than the requirements of present document.

E.2 EMC requirement comparison table

Table E.1: Comparison of CI emission measurement requirements

Radio Equipment Directive 2014/53/EU [i.1], Article 3.1b)		Medical Device Regulation (EU) 2017/745 [i.10]	
Description	**Requirements**	**Description**	**Requirements**
Radiated emission according to ETSI EN 301 489-1 [1], clause 8.2	Only applicable for ancillary equipment. Enclosure Port is measured according to related Article 3.2 standard within Spurious Emission requirements.	Conducted and radiated RF emissions according to EN 60601-1-2 [i.9], clause 7.1.6	ME equipment and ME systems that include radio equipment (e.g. RF transmitters, receivers, transceivers) and have been tested together with the radio equipment and found to comply with applicable national radio regulations are exempt from testing to CISPR electromagnetic disturbance requirements, provided the EMISSIONS limits of the applicable national radio regulations are less than or equal to the corresponding applicable CISPR electromagnetic disturbance limits. ME equipment and ME systems that include RF transmitters are exempt from the emissions requirements of this collateral standard in the dedicated transmission band of the transmitter.

Table E.2: Comparison of CI immunity testing requirements

Radio Equipment Directive 2014/53/EU [i.1], Article 3.1b)		Medical Device Regulation (EU) 2017/745 [i.10]	
Description	**Requirements**	**Description**	**Requirements**
RF electro-magnetic field acc. ETSI EN 301 489-1 [1], clauses 9.2.1 and 9.2.2	**Frequency range:** 80 MHz to 6 000 MHz **Test level:** 3 V/m with 80 % AM by a sinusoidal audio signal of 1 kHz	RF electro-magnetic field acc. EN 60601-1-2 [i.9], table 4, clause 8.9	**Frequency range:** 80 MHz to 2,7 GHz **Test level:** 10 V/m with 80 % AM at 1 kHz
		IMMUNITY to proximity fields from RF wireless communications equipment acc. EN 60601-1-2 [i.9], table 9, clause 8.10	**Discrete frequencies:** 385 MHz, 450 MHz, 710 MHz, 745 MHz, 780 MHz, 810 MHz, 870 MHz, 930 MHZ, 1 720 MHz, 1 845 MHz, 1 970 MHz, 2 450 MHz, 5 240 MHz, 5 500 MHz, 5 785 MHz **Test level:** Related to frequency between minimum 9 V/m and maximum 28 V/m, PM interference signal
		RATED power frequency magnetic fields acc. EN 60601-1-2 [i.9], table 4, clause 8.9	**Frequencies:** 50 Hz or 60 Hz **Test level:** Related to frequency 30 A/m
		Interference signal acc. EN 45502-2-3 [i.8], clause 27.3	**Discrete frequencies:** 16,6 Hz ≤ f < 10 MHz **Test level:** Related to frequency 0,15 A/m to 480 A/m
		Interference signal acc. EN 45502-2-3 [i.8], clause 27.4	**Discrete frequencies:** 10 MHz ≤ f < 3 000 MHz **Test level:** 40 V/m to 200 V/m
Electrostatic discharge acc. ETSI EN 301 489-1 [1], clauses 9.3.1 and 9.3.2	**Test level:** 10 times ±4 kV for contact discharge 10 times ±8 kV for air discharge 10 times ±4 kV on Horizontal Coupling Plane (HCP) and 10 times ±4 kV on Vertical Coupling Plane (VCP)	Electrostatic discharge acc. EN 60601-1-2 [i.9], table 4, clause 8.9	**Test level:** ± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air
		Electrostatic discharge acc. EN 45502-2-3 [i.8], clause 24	**Test level:** 10 times ± 2 kV for contact discharge 5 times ± 8 kV for air discharge

Annex F (informative): Bibliography

- Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services (codification).

Annex G (informative): Change history

Version	Information about changes
V2.1.0	Changes and amendments according to the essential requirements of the RE-D. More information regarding the changes between the different versions of the present document may be found in ETSI EN 301 489-1 [1]
V2.1.1	Correction of circular and generic references and Annex A according to the EC RE-D Desk officer
V2.2.1	Early Draft V0.0.0: Content of published Part 9 V2.1.1 added to the latest available ETSI HS skeleton and updated references used to latest publications. ALD and CI content added to the document. Uploaded to ETSI portal as early draft and presented to TG17 WG3 during June 2024 meeting for review. Draft V0.0.1: Editorial updates done. Uploaded to ETSI portal as stable draft and presented during WG EMC #73 meeting for review. Draft V0.0.2: Changes done during WG EMC #73 meeting and uploaded to ETSI portal as stable draft. Draft V0.0.3: Updates according to WG EMC #73 decisions and actions => document for review in WG EMC #74 uploaded. New Annex D added. Draft V0.0.4: New informative Annex D for Minimum Test Report Information and informative Annex E added for requirement comparison between this document and EN 45502-2-3 Draft V0.0.5: Table 5 & 6 revised for CIs. Annex A clause reference and conditions for 3m revised. Annex E introduction sentence added. Draft V0.0.6: WG EMC #75 meeting review comments implemented, and clean-up version established. Draft V0.0.7: Normative and Informative References updated. Table 7 Special ESD requirements for CI deleted. Informative Annex E Introduction text and table E.1 & E.2 with EMC standard comparison added. Draft V0.0.8: WG EMC#76 meeting revised content in clause 7 (table 5 and 6) and new added informative Annex E approved. Draft V0.0.9: Peer Resolution meeting to discuss peer review results Draft V0.0.10 Resolution Meeting changes related to HAS Consultant Comments done during WG EMC meeting #77

History

Version	Date	Status	
V1.1.1	September 2000	Publication	
V1.2.1	November 2001	Publication	
V1.3.1	August 2002	Publication	
V1.4.1	November 2007	Publication	
V2.1.1	April 2019	Publication	
V2.2.0	March 2026	SRdAP process	EV 20260615: 2026-03-17 to 2026-06-15