



**ElectroMagnetic Compatibility (EMC)**  
**standard for radio equipment and services;**  
**Part 1: Common technical requirements;**  
**Harmonised Standard for ElectroMagnetic Compatibility**

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**Reference**

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REN/ERM-EMC-368

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**Keywords**

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EMC, harmonised standard, radio**ETSI**

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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 standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.16] 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 the Directives, 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 the corresponding Directives and associated EFTA regulations.

The present document is part 1 of a multi-part EMC standard for radio equipment which is structured in the following way:

- All common technical requirements for EMC emission and immunity have been placed in the common part, which is the present document.
- Separate parts have been developed to cover specific product related radio equipment test conditions, test arrangements, performance assessment, performance criteria, etc.
- A clause is included in each of the specific radio parts, entitled "special conditions", which is used as appropriate to cover any deviations or additions to the common requirements set out in the present document.

The present document is part 1 of a multi-part deliverable covering ElectroMagnetic Compatibility (EMC) standard for radio equipment and services, as identified below:

**Part 1:** "Common technical requirements;

Part 2: "Specific conditions for radio paging equipment";

Part 3: "Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz";

Part 4: "Specific conditions for fixed radio links and ancillary equipment";

- Part 5: "Specific conditions for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech) and Terrestrial Trunked Radio (TETRA)";
- Part 6: "Specific conditions for Digital Enhanced Cordless Telecommunications (DECT) equipment";
- Part 9: "Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio and in-ear monitoring devices";
- Part 12: "Specific conditions for Very Small Aperture Terminal, Satellite Interactive Earth Stations operated in the frequency ranges between 4 GHz and 30 GHz in the Fixed Satellite Service (FSS)";
- Part 13: "Specific conditions for Citizens' Band (CB) radio and ancillary equipment (speech and non-speech)";
- Part 15: "Specific conditions for commercially available amateur radio equipment";
- Part 17: "Specific conditions for Broadband Data Transmission Systems";
- Part 19: "Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing positioning, navigation, and timing data";
- Part 20: "Specific conditions for Mobile Earth Stations (MES) used in the Mobile Satellite Services (MSS)";
- Part 22: "Specific conditions for ground based VHF aeronautical mobile and fixed radio equipment";
- Part 27: "Specific conditions for Ultra Low Power Active Medical Implants (ULP-AMI) and related peripheral devices (ULP-AMI-P) operating in the 402 MHz to 405 MHz bands";
- Part 28: "Specific conditions for wireless digital video links";
- Part 29: "Specific conditions for Medical Data Service Devices (MEDS) operating in the 401 MHz to 402 MHz and 405 MHz to 406 MHz bands";
- Part 31: "Specific conditions for equipment in the 9 kHz to 315 kHz band for Ultra Low Power Active Medical Implants (ULP-AMI) and related peripheral devices (ULP-AMI-P)";
- Part 33: "Specific conditions for Ultra Wide Band (UWB) devices";
- Part 34: "Specific conditions for External Power Supply (EPS) for mobile phones";
- Part 35: "Specific requirements for Low Power Active Medical Implants (LP-AMI) operating in the 2 483,5 MHz to 2 500 MHz bands";
- Part 50: "Specific conditions for Cellular Communication Base Station (BS), repeater and ancillary equipment";
- Part 51: "Specific conditions for Automotive, Ground based Vehicles and Surveillance Radar Devices using 24,05 GHz to 24,25 GHz, 24,05 GHz to 24,5 GHz, 76 GHz to 77 GHz and 77 GHz to 81 GHz";
- Part 52: "Specific conditions for Cellular Communication Mobile and portable radio and ancillary equipment";
- Part 53: "Specific conditions for terrestrial sound broadcasting and digital TV broadcasting service transmitters and associated ancillary equipment";
- Part 54: "Specific conditions for ground based aeronautical and meteorological radars".
- NOTE: Parts 7, 8, 10, 11, 14, 16, 18, 23, 24, 25, 26 and 32 of this multi-part deliverable have been removed from this listing as they do not cover the new Directive in force, Directive 2014/53/EU [i.1] and Directive 2014/30/EU [i.2].

| 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             |

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## 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.

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## Introduction

Product dependent arrangements necessary to perform the EMC tests on dedicated types of radio communications equipment, and the assessment of test results, are detailed in the appropriate relevant radio technology parts of ETSI EN 301 489 series [i.13] details of which can be found in annex C of the present document.

The environment classification used in the present document refers to the environment classification used in:

- CENELEC EN 61000-6-3 [i.4] and CENELEC EN 61000-6-1 [i.5] for the residential, commercial and light industrial environment; or
- CENELEC EN 61000-6-2 [i.15] and CENELEC EN 61000-6-4 [i.14] for the industrial environment; or
- ETSI TR 101 651 [i.6] for the telecommunication centre environment; or
- ISO 7637-2 [8] for the vehicular environment.

The immunity requirements within the present document are derived from the generic immunity standard for the residential, commercial and light industrial environment.

When it is required to evaluate the EMC performance of "combined radio and non-radio equipment", ETSI EG 203 367 [i.3] provides guidance upon the application of the various harmonised standards, including the present document, that could potentially apply to such equipment.

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# 1 Scope

The present document specifies methods of measurements and technical characteristics for radio equipment and associated ancillary equipment, excluding broadcast receivers, in respect of ElectroMagnetic Compatibility (EMC).

Technical specifications related to the antenna port of radio equipment and radiated emissions from the enclosure port of radio equipment and combinations of radio and associated ancillary equipment are not included in the present document. Such technical specifications are normally found in the relevant product standards for the effective use of the radio spectrum.

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

NOTE 2: Other standards may apply in place of the present document, e.g. product specific standards in the ETSI EN 301 489 [i.13] series.

---

# 2 References

## 2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version 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] CENELEC EN 55032 (2015): "Electromagnetic compatibility of multimedia equipment - Emission Requirements".
- [2] CENELEC EN 61000-4-2 (2009): "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".
- [3] CENELEC EN 61000-4-3 (2006), A1 (2008) and A2 (2010): "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".
- [4] CENELEC EN 61000-4-4 (2012): "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".
- [5] CENELEC EN 61000-4-5 (2014): + A1(2017): "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test".
- [6] CENELEC EN 61000-4-6 (2014): "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields".
- [7] CENELEC EN 61000-4-11 (2004): "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".
- [8] ISO 7637-2 (2004): "Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only".

- [9] CENELEC 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  $\leq 16$  A per phase and not subject to conditional connection".
- [10] CISPR 25 (2nd Edition 2002) and COR1 (2004): "Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices - Limits and methods of measurement".

NOTE: The dated reference of CISPR 25 has not been updated to the latest version in order to maintain alignment with the requirements of UNECE Reg 10.

- [11] CENELEC EN 61000-3-12 (2011): "Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current  $> 16$  A and  $\leq 75$  A per phase".
- [12] CENELEC EN 61000-3-11 (2000): "Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current  $\leq 75$  A and subject to conditional connection".
- [13] CENELEC EN 50561-3 (2016): "Power line communication apparatus used in low-voltage installations - Radio disturbance characteristics - Limits and methods of measurement - Part 3: Apparatus operating above 30 MHz".
- [14] CENELEC EN 50561-1 (2013): "Power line communication apparatus used in low-voltage installations - Radio disturbance characteristics - Limits and methods of measurement - Part 1: Apparatus for in-home use".
- [15] CENELEC EN 61000-3-2 (2014): "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current  $\leq 16$  A per phase)".
- [16] CENELEC EN 61000-4-34 (2007), A1 (2009): "Electromagnetic compatibility (EMC) - Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase".

## 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] 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] Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast).
- [i.3] ETSI EG 203 367: "Guide to the application of harmonised standards covering articles 3.1b and 3.2 of the Directive 2014/53/EU (RED) to multi-radio and combined radio and non-radio equipment".
- [i.4] CENELEC EN 61000-6-3 (2007) + A1(2011): "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments".
- [i.5] CENELEC EN 61000-6-1 (2007): "Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments".

- [i.6] ETSI TR 101 651 (V2.1.1): "Classification of the electromagnetic environment conditions for equipment in telecommunication networks".
- [i.7] IEC 60050-161: "International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility".
- [i.8] ITU Radio Regulations (Article 1, Section VI) definition 1.153.
- [i.9] Void.
- [i.10] Void.
- [i.11] Void.
- [i.12] Void.
- [i.13] ETSI EN 301 489 series: "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services".
- [i.14] CENELEC EN 61000-6-4 (2007) + A1 (2011): "Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments".
- [i.15] CENELEC EN 61000-6-2 (2005): "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments".
- [i.16] 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.17] Void.

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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

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

**ancillary equipment:** electrical or electronic equipment, that is intended to be used with a receiver or transmitter

NOTE: It is considered as an ancillary equipment if:

- the equipment is intended for use with a receiver or transmitter to provide additional operational and/or control features to the radio equipment, (e.g. to extend control to another position or location); and
- the ancillary equipment cannot be used without being connected to radio equipment to provide user functions independently of a receiver or transmitter; and
- the receiver or transmitter, to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions);
- an example of ancillary equipment would be a docking station for radio equipment whose interface is dedicated to a particular product or range of products.

**antenna port:** port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy

**associated equipment:** equipment needed to exercise and/or monitor the operation of the EUT

**base station:** radio equipment intended for operation at a fixed location which is not defined as portable equipment

**broadcast receivers:** equipment containing a tuner that is intended for the reception of broadcast services

NOTE: These broadcast services are typically television and radio, including terrestrial broadcast and satellite broadcast.

**conditional connection:** connection of equipment which requires the user's supply at the interface point to have an impedance lower than the reference impedance  $Z_{ref}$  in order that the equipment emissions comply with the limits in CENELEC EN 61000-3-11 [12]

NOTE: Meeting the voltage change limits is not the only condition for connection; emission limits for other phenomena such as harmonics, may also have to be satisfied.

**continuous phenomena (continuous disturbance):** electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects

NOTE: See IEC 60050-161 [i.7].

**Electrical/Electronic Sub-Assembly (ESA):** electrical and/or electronic device or set(s) of devices intended to be part of a vehicle, together with any associated electrical connections and wiring, which performs one or more specialized functions

**enclosure port:** physical boundary of the equipment through which electromagnetic fields may radiate or impinge

NOTE: In the case of integral antenna equipment, this port is inseparable from the antenna port.

**exclusion band:** frequency range(s) not subject to test or assessment

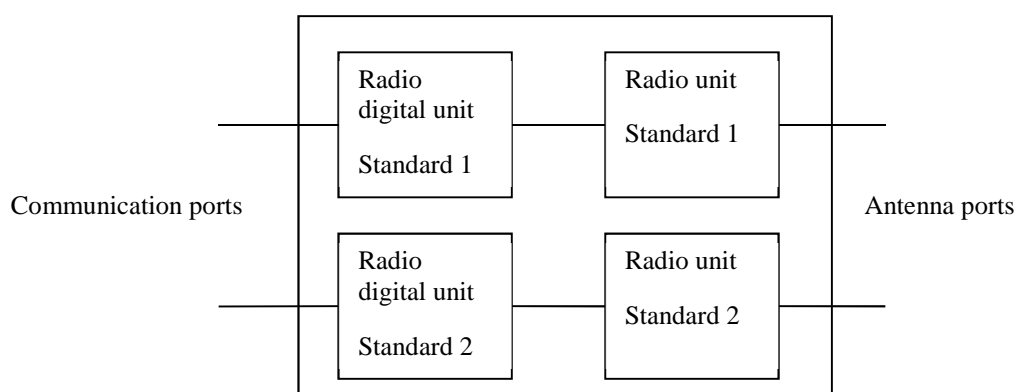
**fixed-use:** use of equipment either in a fixed location permanently or connected to an ac mains adaptor on a temporary basis

**integral antenna:** antenna designed for permanent connection to the equipment and considered part of the enclosure port

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

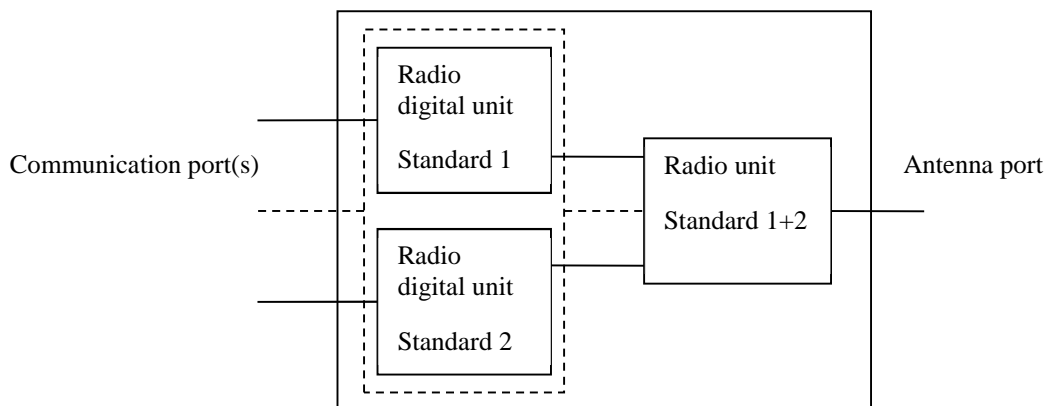
**manufacturer:** any natural or legal person who manufactures radio equipment or has radio equipment designed or manufactured, and markets that equipment under his name or trade mark

**multi-radio equipment:** radio equipment containing two or more radio transmitters and/or receivers using different technologies that may operate simultaneously



**Figure 1: Multi-radio equipment**

**multi-standard-radio:** radio equipment with ability of its receiver and transmitter to process two or more carriers in common active RF components simultaneously in a declared RF bandwidth, where at least one carrier is of a different radio access technology than the other carrier(s)



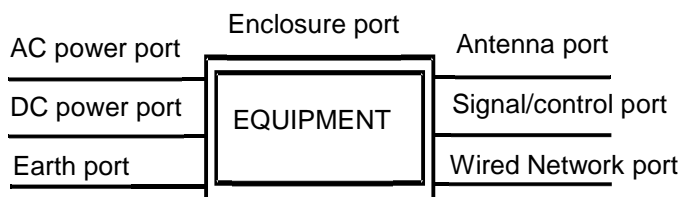
**Figure 2: Multi-standard-radio equipment**

**occupied bandwidth:** width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage  $\beta/2$  of the total mean power of a given emission; unless otherwise specified in a Recommendation ITU-R for the appropriate class of emission, the value of  $\beta/2$  should be taken as 0,5 % [i.8]

**operating frequency band(s):** range(s) of radio frequencies covered by the Equipment Under Test (EUT) without any change of units

**port:** particular interface, of the specified equipment, with the electromagnetic environment

NOTE 1: For example, any connection point on an equipment intended for connection of cables to or from that equipment is considered as a port (see figure 3).



**Figure 3: Examples of ports**

NOTE 2: An interface, which uses optical fibre, is not a port for the purposes of testing because it does not interact with the electromagnetic environment within the frequency range, which is applicable for the present document. An optical fibre interface may still be used in the assessment of performance.

NOTE 3: In the case of integral antenna equipment the antenna port is the same as the enclosure port.

**portable equipment:** radio equipment intended for portable use and powered by integral batteries or battery

NOTE: Devices will typically be handheld.

**portable-use:** use of equipment in a temporary location and not connected to an external power adaptor

**radio equipment:** "An electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radio determination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radio determination", definition from Directive 2014/53/EU [i.1].

NOTE: It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.

**removable antenna:** antenna which may be removed for the test

**signal port:** port intended for the interconnection of components of an EUT, or between an EUT and AE and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it)

**transient phenomena (transient disturbance):** pertaining to or designating a phenomena or a quantity which varies between two consecutive steady states during a time interval short compared with the time-scale of interest

NOTE: See IEC 60050-161 [i.7].

**vehicle use:** radio equipment intended for installation and use in a vehicle, and powered by the main battery of the vehicle

**wired network port:** point of connection for voice, data and signalling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network (for example CATV, PSTN, ISDN, xDSL, LAN and similar networks)

NOTE: These ports may support screened or unscreened cables and may also carry AC or DC power where this is an integral part of the telecommunication specification.

## 3.2 Symbols

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

|   |   |
|---|---|
| $\beta$                                 | Bandwidth   |
| $\text{Band}_{\text{rx}}(\text{lower})$ | Lower edge, in terms of frequency, of the tuning range or allocated band of the receiver under assessment |
| $\text{Band}_{\text{rx}}(\text{upper})$ | Upper edge, in terms of frequency, of the tuning range or allocated band of the receiver under assessment |
| $\text{BW}_{\text{RX}}$                 | Bandwidth of Receiver (or receiver part of transceiver)   |
| $\text{ChW}_{\text{RX}}$                | Channel Width of Receiver (or receiver part of transceiver)   |
| $\text{EXband}(\text{lower})$           | Exclusion band lower frequency edge   |
| $\text{EXband}(\text{upper})$           | Exclusion band upper frequency edge   |

## 3.3 Abbreviations

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

|       |   |
|-------|---|
| AC    | Alternating Current                                   |
| AE    | Associated Equipment                                  |
| AMN   | Artificial Mains Network                              |
| AN    | Artificial Network                                    |
| BS    | Base Station  |
| CB    | Citizens Band   |
| CDN   | Coupling/Decoupling Network                           |
| CISPR | International Special Committee on Radio Interference |

NOTE: From the French: Comité International Spécial des Perturbations Radioélectriques.

|       |  |
|-------|--|
| DC    | Direct Current                                 |
| EFTA  | European Free Trade Association                |
| EG    | ETSI Guide                                     |
| EM    | ElectroMagnetic                                |
| EMC   | ElectroMagnetic Compatibility                  |
| EPS   | External Power Supply                          |
| ESA   | Electrical/Electronic Sub-Assembly             |
| EU    | European Union                                 |
| EUT   | Equipment Under Test                           |
| FSS   | Fixed Satellite Service                        |
| GSM   | Global System for Mobile communications        |
| IF    | Intermediate Frequency                         |
| ISDN  | Integrated Services Digital Networks           |
| ISO   | International Organization for Standardization |
| ITU-R | International Telecommunication Union - Radio  |
| MEDS  | Medical Data Service devices                   |
| MES   | Mobile Earth Station                           |

|       |   |
|-------|---|
| MSS   | Mobile Satellite Services                   |
| OOB   | Out Of Band                                 |
| PLC   | PowerLine Communications                    |
| PMR   | Private Mobile Radio                        |
| PSTN  | Public Switched Telecommunications Networks |
| RF    | Radio Frequency                             |
| rms   | root mean square                            |
| ROMES | Receive Only Mobile Earth Station           |
| SRD   | Short Range Device                          |
| TV    | TeleVision                                  |
| UE    | User Equipment                              |
| UWB   | Ultra Wide Band                             |
| VHF   | Very High Frequency                         |
| xDSL  | x-type Digital Subscriber Line              |

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## 4 Test conditions

### 4.1 General

The test configuration and mode of operation shall represent the intended use and shall be recorded in the test report.

### 4.2 Arrangements for test signals

#### 4.2.0 General

Standalone receivers and transmitters shall be tested separately. Transceivers shall be tested so that operation in each direction is confirmed.

#### 4.2.1 Arrangements for test signals at the input of transmitters

The transmitter shall be exercised with a signal, representing the EUT's intended use.

Where this signal is provided by an external source, the source should be located outside the test environment.

#### 4.2.2 Arrangements for test signals at the RF output of transmitters

The measuring equipment for the wanted RF output signal from the transmitter under test should be located outside the test environment.

For transmitters with an integral antenna, the wanted RF output signal to establish a communication link shall be delivered from the EUT to an antenna located within the test environment. This antenna shall be connected to the external monitoring equipment by means not subject to influence by signals within the test environment.

For transmitters with an antenna connector, the wanted RF output signal to establish a communication link shall be delivered from the antenna connector to the external measuring equipment by a shielded transmission line, such as a coaxial cable.

The level of the wanted RF output signal in transmit mode of operation shall be set to the maximum rated RF power for the EUT.

#### 4.2.3 Arrangements for test signals at the RF input of receivers

The signal source providing the receiver under test with the wanted RF input signal should be located outside the test environment.

For receivers with an integral antenna, the wanted RF input signal to establish a communication link shall be presented to the EUT from an antenna located within the test environment. This antenna shall be connected to the external RF signal source by means not subject to influence by signals within the test environment.

For receivers with an antenna connector, the wanted RF input signal to establish a communication link should be presented to the antenna connector of the EUT by a shielded transmission line, such as a coaxial cable. This cable shall be connected to the external RF signal source.

The level of the wanted RF input signal shall be set to a maximum of 40 dB above the minimum level usable receiver signal level. For radiated immunity testing this input level is measured while the power amplifiers generating the EM disturbance are switched on, but without excitation.

**NOTE:** This increased level of the wanted RF input signal is expected to represent a signal level and is intended to avoid the broadband noise from the power amplifiers generating the EM disturbance from influencing the measurement.

## 4.2.4 Arrangements for test signals at the output of receivers

The measuring equipment for the output signal from the receiver under test should be located outside the test environment.

If the receiver has an output connector or port providing the wanted output signal, then this port should be used via a cable, consistent with the standard cable used in its intended use, connected to the external measuring equipment outside the test environment.

For receivers without an output connector, thus providing a visual or acoustic indicating of the received signal, this output should be coupled via an electrically non-conductive means to the external monitoring equipment outside the test environment (e.g. via a camera to read a display).

For receivers with an analogue speech output the audio output from the acoustic transducer should be coupled via an electrically non-conductive acoustic tube to an external audio distortion meter or other appropriate measuring equipment outside of the test environment. Where it is not practical to use an electrically non-conductive acoustic tube, then other means of connecting the receiver output signal to the external audio distortion meter or other measuring equipment should be provided and recorded in the test report.

A test jig may be used with the equipment submitted for test.

## 4.3 RF exclusion band of radio equipment

### 4.3.1 General

The exclusion bands shall be derived using the methodologies detailed in clauses 4.3.2 and 4.3.3.

Whenever an exclusion band is applied, the specific frequency range(s) excluded from assessment shall be detailed in the technical documentation.

### 4.3.2 Exclusion band for transmitters or the transmitter part of transceivers

#### 4.3.2.1 General

Exclusion bands shall not be applied when measuring transmitters in standby mode.

#### 4.3.2.2 Channelized Equipment

For channelized equipment the exclusion band shall extend 250 % of the channel width either side of the transmitter centre frequency.

**NOTE:** Exclusion band of 250 % is based on the ITU Radio Regulations [i.8], as the boundary between OOB and Spurious Domain.

### 4.3.2.3 Non-Channelized Equipment

For non-channelized equipment the exclusion band shall extend 250 % of the occupied bandwidth either side of the transmitter centre frequency.

NOTE: Exclusion band of 250 % is based on the ITU Radio Regulations [i.8], as the boundary between OOB and Spurious Domain.

## 4.3.3 Exclusion band for receivers or the receiver part of transceivers

### 4.3.3.1 Applicability

Exclusion bands are not applied when testing emissions of receivers or receiver part of transceivers.

### 4.3.3.2 Channelized Equipment

For channelized equipment the exclusion band shall be calculated by using the following formulae:

For the lower edge for the exclusion band:

$$EXband(lower) = Band_{RX}(lower) - nChW_{RX}$$

and for the upper edge of the exclusion band:

$$EXband(upper) = Band_{RX}(upper) + nChW_{RX}$$

Where n = number of channel widths required for exclusion band.

NOTE: For equipment that support multiple channel widths the Channel Width used is the widest supported by the EUT.

Where the present document is being used in a stand-alone basis, the value of n shall be 1.

### 4.3.3.3 Non-Channelized Equipment

For non-channelized equipment the exclusion band shall be calculated by using the following formula:

For the lower edge for the exclusion band:

$$EXband(lower) = Band_{RX}(lower) - nBW_{RX}$$

and for the upper edge of the exclusion band:

$$EXband(upper) = Band_{RX}(upper) + nBW_{RX}$$

Where n = multiple of whole bandwidths required to define exclusion band.

Bandwidth of Receiver is the occupied bandwidth of the corresponding transmitter signal.

Where the present document is being used in a stand-alone basis, the value of n shall be 1.

## 4.4 Void

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## 5 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; or
- to the combination of ancillary and radio equipment, both within the measurement area.

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

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## 6 Performance criteria

### 6.0 Introduction

The performance criteria are used to take a decision on whether a radio equipment passes or fails immunity tests.

For the purpose of the present document two categories of performance criteria apply:

- Performance criteria for continuous phenomena.
- Performance criteria for transient phenomena.

NOTE: Normally, the performance criteria depends upon the type of radio equipment and/or its intended application. Thus, the present document only contains general performance criteria commonly used for the assessment of radio equipment.

### 6.1 Performance criteria for continuous phenomena

During the test, the equipment shall:

- continue to operate as intended;
- not unintentionally transmit;
- not unintentionally change its operating state;
- not unintentionally change critical stored data.

### 6.2 Performance criteria for transient phenomena

For all ports and transient phenomena with the exception described below, the following applies:

- The application of the transient phenomena shall not result in a change of the mode of operation (e.g. unintended transmission) or the loss of critical stored data.
- After application of the transient phenomena, the equipment shall operate as intended.

For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies:

- For products with only one symmetrical port intended for connection to outdoor lines, loss of function is allowed, provided the function is self-recoverable, or can be otherwise restored. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.
- For products with more than one symmetrical port intended for connection to outdoor lines, loss of function on the port under test is allowed, provided the function is self-recoverable. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

## 7 Applicability tables

### 7.0 Introduction

Tables 1 and 2 list the EMC tests for radio and/or associated ancillary equipment.

The applicability of EMC tests depends upon the type of radio and/or associated ancillary equipment under test.

In the case that the present document is used on a stand-alone basis, both the decision and the justification not to apply any particular test to any particular port shall be recorded in the test report.

Signal and control ports intended for connection to lines which may carry power shall be assessed only as signal and control ports.

For multiple use radio and/or ancillary equipment more than one set of equipment test requirements listed in tables 1 and 2 has to be taken into account.

### 7.1 Emissions

**Table 1: Emission requirements**

| Phenomenon                       | Port                                  | Applicability |                |                | Reference clause |
|----------------------------------|---------------------------------------|---------------|----------------|----------------|------------------|
|                                  |                                       | Fixed-Use     | Vehicle Use    | Portable Use   |                  |
| radiated emission                | enclosure port of ancillary equipment | applicable    | applicable     | applicable     | 8.2              |
| conducted emission               | DC power input/output port            | applicable    | applicable     | not applicable | 8.3              |
| conducted emission               | AC mains input/output port            | applicable    | not applicable | not applicable | 8.4              |
| harmonic current emissions       | AC mains input port                   | applicable    | not applicable | not applicable | 8.5              |
| voltage fluctuations and flicker | AC mains input port                   | applicable    | not applicable | not applicable | 8.6              |
| conducted emission               | wired network port                    | applicable    | not applicable | not applicable | 8.7              |

### 7.2 Immunity

**Table 2: Immunity requirements**

| Phenomenon                                      | Port   | Applicability |                |                | Reference clause |
|---|--|---------------|----------------|----------------|------------------|
|   |  | Fixed-Use     | Vehicle Use    | Portable-Use   |                  |
| RF electromagnetic field (80 MHz to 6 000 MHz ) | enclosure port   | applicable    | applicable     | applicable     | 9.2              |
| electrostatic discharge                         | enclosure  | applicable    | not applicable | applicable     | 9.3              |
| fast transients common mode                     | signal, wired network and control ports, DC and AC power ports | applicable    | not applicable | not applicable | 9.4              |
| RF common mode 0,15 MHz to 80 MHz               | signal, wired network and control ports, DC and AC power ports | applicable    | applicable     | not applicable | 9.5              |

| Phenomenon                              | Port  | Applicability  |                |                | Reference clause |
|---|---|----------------|----------------|----------------|------------------|
|   |   | Fixed-Use      | Vehicle Use    | Portable-Use   |                  |
| transients and surges                   | DC power input ports                            | not applicable | applicable     | not applicable | 9.6              |
| voltage dips and interruptions          | AC mains power input ports                      | applicable     | not applicable | not applicable | 9.7              |
| surges, line to line and line to ground | AC mains power input ports, wired network ports | applicable     | not applicable | not applicable | 9.8              |

Tables 3 and 4: Void

## 8 Methods of measurement and limits for EMC emissions

### 8.1 Introduction

#### 8.1.1 Emissions test overview

Conducted emission testing is performed on all radio equipment containing any wired connections.

Radiated emission testing on the antenna port and/or the enclosure port (see clause 8.2) is not required for radio equipment as it is covered by the appropriate standard under article 3.2 of Directive 2014/53/EU [i.1].

#### 8.1.2 Test configuration

This clause defines the requirements for test configurations:

- measurements shall be made in the operational mode(s) producing the largest emission in the frequency band being investigated consistent with intended use;
- the equipment shall be configured in a manner which is representative of intended use, where practical;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of ports are covered;
- ports shall be connected to either a piece equipment representative of intended use or to a representative piece of cable terminated to simulate the impedance of the connected equipment;
- the configuration and mode of operation during the measurements shall be noted in the test report.

### 8.2 Enclosure port

#### 8.2.1 General

This test is only applicable to ancillary equipment not incorporated in the radio equipment and assessed separately from its associated radio equipment.

This test shall be performed on a representative configuration of the ancillary equipment.

## 8.2.2 Test method

The test method shall be in accordance with CENELEC EN 55032 [1], annex A.2.

## 8.2.3 Limits

The ancillary equipment shall meet the class B limits given in CENELEC EN 55032 [1], annex A, tables A.4 and A.5.

Alternatively, for ancillary equipment intended to be used exclusively in an industrial environment or telecommunication centres, the class A limits given in CENELEC EN 55032 [1], annex A, tables A.2 and A.3 may be used.

# 8.3 DC power input/output ports

## 8.3.1 General

This test is applicable for radio equipment and ancillary equipment for fixed use that may be connected to a local DC power network or to local battery with connecting cables longer than 3 m (see annex C).

If the DC power cable of the radio and/or the ancillary equipment is less than or equal to 3 m in length, and intended for direct connection to a dedicated AC/DC power supply, then the measurement shall be performed on the AC power input port of that power supply as specified in clause 8.4. If the DC power cable is longer than 3 m, then the measurement shall additionally be performed on the DC power port of the radio and/or ancillary equipment.

If the DC power cable between the mobile radio and/or ancillary equipment and the dedicated DC/DC power converter is less than or equal to 3 m in length, then the measurement can be limited to the DC power input port of that power converter only. If this DC power cable is longer than 3 m, then the measurement shall additionally be performed on the DC power port of the mobile radio and/or ancillary equipment.

This test shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

This test is intended to assess the level of internally generated electrical noise present on the DC power input/output ports.

## 8.3.2 Test method

For mobile radio and ancillary equipment intended to be connected to the vehicle's onboard DC mains, an Artificial Network (AN) as specified in CISPR 25 [10] annex D shall be used and be connected to a DC power source.

For all other equipment the test method for AC mains power port specified in CENELEC EN 55032 [1], annex A.3, shall be used.

The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies (see clause 4.3 of the present document) for measurements in the transmit mode of operation.

For emission measurements on DC output ports the relevant port shall be connected via an AMN/AN to a load drawing the rated current of the source.

## 8.3.3 Limits

The equipment shall meet the limits below including the average limit and the quasi-peak limit when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in clause 8.3.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector is unnecessary.

The equipment shall meet the limits shown in table 5.

**Table 5: Limits for conducted emissions**

| <b>Frequency range</b> | <b>Limit (quasi-peak)<br/>(dB<math>\mu</math>V)</b> | <b>Limit (average)<br/>(dB<math>\mu</math>V)</b> |
|------------------------|---|--|
| 0,15 MHz to 0,5 MHz    | 79  | 66   |
| 0,5 MHz to 30 MHz      | 73  | 60   |

## 8.4 AC mains power input/output ports

### 8.4.1 General

This test is applicable for radio equipment and/or ancillary equipment for fixed use powered by the AC mains.

This test shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

This test assesses the level of internally generated electrical noise present on the AC power input/output ports.

### 8.4.2 Test method

The test method shall be in accordance with CENELEC EN 55032 [1], annex A.3, and the Artificial Mains Networks (AMNs) shall be connected to the AC mains power source.

The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies (see clause 4.3) for measurements in the transmit mode of operation.

For emission measurements on AC output ports of the EUT the relevant port shall be connected via an AMN to a load drawing the rated current of the source. In case where the AC output port is directly connected (or via a circuit breaker) to the AC power input port of the EUT the AC power output port need not to be tested.

### 8.4.3 Limits

#### 8.4.3.1 General

The equipment shall meet the limits below including the average limit and the quasi-peak limit when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in clause 8.4.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector is unnecessary.

#### 8.4.3.2 AC Power port used for power supply only

The equipment shall meet the class B limits given in CENELEC EN 55032 [1], annex A, table A.10.

Alternatively, for equipment intended to be used in an industrial environment or a telecommunication centre, the class A limits given in CENELEC EN 55032 [1], annex A, table A.9 can be used.

#### 8.4.3.3 AC power input port also used for PLC Communications

Where the A.C power port of the equipment is also used for PLC communication up to 30 MHz then the EUT shall comply with the requirements of CENELEC EN 50561-1 [14], clause 6, instead of those in clause 8.4.3.2 of the present document.

Where the A.C power port of the equipment is also used for PLC communication above 30 MHz then the EUT shall comply with the requirements of CENELEC EN 50561-3 [13], clause 6, instead of those in clause 8.4.3.2 of the present document.

## 8.5 Harmonic current emissions (AC mains input port)

For equipment with an input current up to and including 16A per phase, the classification from CENELEC EN 61000-3-2 [15], clause 5, shall apply together with the limits from CENELEC EN 61000-3-2 [15], clause 7, and the evaluation requirements of CENELEC EN 61000-3-2 [15], clause 6.

For equipment with an input current of greater than 16A per phase the limits from CENELEC EN 61000-3-12 [11], clause 5 shall apply together with the evaluation requirements of CENELEC EN 61000-3-12 [11], clause 7.

## 8.6 Voltage fluctuations and flicker (AC mains input port)

For equipment with an input current up to and including 16A per phase, if no conditional connection is needed, the limits from CENELEC EN 61000-3-3 [9], clause 5 shall apply together with the evaluation requirements of CENELEC EN 61000-3-3 [9], clause 6.

For equipment with an input current up to and including 16A per phase, where a conditional connection is required, and for equipment with an input current of greater than 16A up to and including 75A per phase, the limits from CENELEC EN 61000-3-11 [12], clause 5 shall apply together with the evaluation requirements of CENELEC EN 61000-3-11 [12], clause 6.

## 8.7 Wired network ports

### 8.7.1 General

This test is applicable for radio equipment and/or ancillary equipment for fixed use which have wired network ports.

This test shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

This test assesses the level of unwanted emissions present at the wired network ports.

### 8.7.2 Test method

The test method shall be in accordance with CENELEC EN 55032 [1], annex A.3.

The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies (see clause 4.3) for measurements in the transmit mode of operation.

### 8.7.3 Limits

The wired network ports shall meet the class B limits given in CENELEC EN 55032 [1], annex A, table A.12.

Alternatively, for equipment intended to be used exclusively in an industrial environment or a telecommunication centre, the class A limits given in CENELEC EN 55032 [1], annex A, table A.11 can be used.

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## 9 Test methods and levels for immunity tests

### 9.1 Test configuration

This clause defines the requirements for test configurations:

- the tests shall take account the test conditions as specified in clause 4;
- the tests shall be carried out at a point within the specified environmental range and at the rated supply voltage for the equipment;

- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- where radio equipment is provided with an integral antenna, it shall be tested with the antenna fitted in a manner representative of intended use;
- for the immunity tests of ancillary equipment, without a separate pass/fail criteria, the receiver or transmitter coupled to the ancillary equipment, shall be used to judge whether the ancillary equipment passes or fails;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports shall be connected to either a piece equipment representative of intended use or to a representative piece of cable terminated to simulate the impedance of the connected equipment;
- ports which are not connected to cables during intended use, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the Equipment Under Test (EUT), precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- the configuration and mode of operation during the tests shall be noted in the test report.

## 9.2 Radio frequency electromagnetic field (80 MHz to 6 000 MHz)

### 9.2.1 General

This test is applicable for radio equipment and associated ancillary equipment.

This test shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

This test assesses the ability of the EUT to operate as intended in the presence of a radio frequency electromagnetic field disturbance.

### 9.2.2 Test method

The test method shall be in accordance with CENELEC EN 61000-4-3 [3], clauses 6, 7 and 8.

The following requirements and evaluation of test results shall apply:

- the test level shall be 3 V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz. If the wanted signal is modulated at 1 000 Hz, then an audio signal of 400 Hz shall be used;
- the test shall be performed over the frequency range 80 MHz to 6 000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers (see clause 4.3), as appropriate;
- for receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency;
- the dwell time of the test phenomena at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond;

NOTE: Dwell time is product dependent.

- the frequencies selected and used during the test shall be recorded in the test report.

### 9.2.3 Performance criteria

The performance criteria for continuous phenomena shall apply (as specified in clause 6.1).

## 9.3 Electrostatic discharge

### 9.3.1 General

This test is applicable for radio equipment and associated ancillary equipment.

This test shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

This test assesses the ability of the EUT to operate as intended in the event of an electrostatic discharge.

### 9.3.2 Test method

The test method shall be in accordance with CENELEC EN 61000-4-2 [2], clauses 6, 7 and 8.

For radio equipment and ancillary equipment the following requirements and evaluation of test results shall apply.

The test severity level for contact discharge shall be  $\pm 4$  kV and for air discharge  $\pm 8$  kV. All other details, including intermediate test levels, are contained within CENELEC EN 61000-4-2 [2], clause 5.

Electrostatic discharges shall be applied to all exposed surfaces of the EUT except where the user documentation specifically indicates a requirement for appropriate protective measures (as specified in CENELEC EN 61000-4-2 [2], clauses 8.3.2 and 8.3.3).

### 9.3.3 Performance criteria

The performance criteria for transient phenomena shall apply (as specified in clause 6.2).

## 9.4 Fast transients, common mode

### 9.4.1 General

This test shall be performed on the AC mains power port (if any) of radio equipment and associated ancillary equipment.

This test shall be additionally performed on signal ports, wired network ports, control ports, and DC power ports, of radio equipment and associated ancillary equipment, if the cables may be longer than 3 m.

Where this test is not carried out on any port because it is not intended to be used with cables longer than 3 m, a list of the ports, which were not tested for this reason, shall be included in the test report.

This test assesses the ability of the EUT to operate as intended in the event of fast transients present on one of the input/output ports.

### 9.4.2 Test method

The test method shall be in accordance with CENELEC EN 61000-4-4 [4], clauses 7 and 8.

The following requirements and evaluation of test results shall apply:

- the test level for signal ports, wired network ports (excluding xDSL), and control ports shall be 0,5 kV open circuit voltage at a repetition rate of 5 kHz as given in CENELEC EN 61000-4-4 [4], clause 5;
- the test level for xDSL wired network ports shall be 0,5 kV open circuit voltage at a repetition rate of 100 kHz as given in CENELEC EN 61000-4-4 [4], clause 5;

- the test level for DC power input ports shall be 0,5 kV open circuit voltage at a repetition rate of 5 kHz as given CENELEC EN 61000-4-4 [4], clause 5;
- the test level for AC mains power input ports shall be 1 kV open circuit voltage at a repetition rate of 5 kHz as given CENELEC EN 61000-4-4 [4], clause 5.

### 9.4.3 Performance criteria

The performance criteria for transient phenomena shall apply (as specified in clause 6.2).

## 9.5 Radio frequency, common mode

### 9.5.1 General

This test shall be performed on the AC mains power port (if any) of radio equipment and associated ancillary equipment.

This test shall be additionally performed on signal ports, wired network ports, control ports, and DC power ports, of radio equipment and associated ancillary equipment, if the cables may be longer than 3 m.

Where this test is not carried out on any port because it is not intended to be used with cables longer than 3 m, a list of the ports, which were not tested for this reason, shall be included in the test report.

This test shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

This test assesses the ability of the EUT to operate as intended in the presence of a radio frequency disturbance on the input/output ports.

### 9.5.2 Test method

The test method shall be in accordance with CENELEC EN 61000-4-6 [6], clauses 6 and 8.

The following requirements and evaluation of test results shall apply:

- the test level shall be severity level 2 as given in CENELEC EN 61000-4-6 [6], clause 5 corresponding to 3 V rms unmodulated. The test signal shall then be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz. If the wanted signal is modulated at 1 000 Hz, then the test signal of 400 Hz shall be used;
- the test shall be performed over the frequency range 150 kHz to 80 MHz with the exception of an exclusion band for transmitters, and for receivers and duplex transceivers, (see clause 4);
- for receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary frequency in the frequency range 150 kHz to 80 MHz;
- the injection method to be used shall be selected according to the basic standard CENELEC EN 61000-4-6 [6], clause 7;
- responses on receivers or receiver parts of transceivers occurring at discrete frequencies which are narrow band responses (spurious responses), are disregarded from the test (as specified in clause 4);  
the dwell time of the test phenomena at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond;
- the frequencies of the immunity test signal selected and used during the test shall be recorded in the test report.

### 9.5.3 Performance criteria

The performance criteria for continuous phenomena shall apply (as specified in clause 6.1).

## 9.6 Transients and surges in the vehicular environment

### 9.6.1 General

These tests are applicable to radio and ancillary equipment intended for vehicular use.

These tests shall be performed on nominal 12 V and 24 V DC supply voltage input ports of mobile radio and ancillary equipment, which are also intended for mobile use in vehicles.

These tests shall be performed on a representative configuration of the mobile radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

These tests assess the ability of the EUT to operate as intended in the event of transients and surges present on their DC power input ports in a vehicular environment.

### 9.6.2 Test method

The test method shall be in accordance with ISO 7637-2 [8], clause 4 for 12 V DC and 24 V DC powered equipment.

The test method shall be in accordance with ISO 7637-2 [8], clause 4, applying pulses 1, 2a, 2b, 3a, 3b, and 4, using immunity test level III. For the purpose of EMC testing it is sufficient to apply pulses 1, 2a, 2b and 4, 10 times each, and apply the test pulses 3a and 3b for 20 minutes each.

### 9.6.3 Performance criteria

Where, pulse 3a and 3b are applied, the performance criteria for continuous phenomena shall apply (see clause 6.1).

Where pulse 1, 2a, 2b, and 4 are applied, the performance criteria for transient phenomena shall apply (see clause 6.2), with the exception that a communication link need not to be maintained during the EMC exposure and may have to be re-established.

## 9.7 Voltage dips and interruptions

### 9.7.1 General

This test shall be performed on the AC mains power port (if any) of radio equipment and associated ancillary equipment.

These tests shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

These tests assess the ability of the EUT to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

### 9.7.2 Test method

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with CENELEC EN 61000-4-11 [7], clause 8 or for equipment requiring a mains current of greater than 16 A CENELEC EN 61000-4-34 [16], clause 8 shall be used.

The test levels shall be:

- voltage dip: 0 % residual voltage for 0,5 cycle;
- voltage dip: 0 % residual voltage for 1 cycle;
- voltage dip: 70 % residual voltage for 25 cycles (at 50 Hz);
- voltage interruption: 0 % residual voltage for 250 cycles (at 50 Hz).

### 9.7.3 Performance criteria

For a voltage dip the following performance criteria apply:

- The performance criteria for transient phenomena shall apply (as specified in clause 6.2).

For a voltage interruption the following performance criteria apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria for transient phenomena shall apply as specified in clause 6.2);
- in the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator;
- no unintentional responses shall occur at the end of the test;
- in the event of loss of function(s) or in the event of loss of user stored data, this fact shall be recorded in the test report.

## 9.8 Surges

### 9.8.1 General

This test shall be performed on the AC mains power input port (if any) of radio equipment and associated ancillary equipment.

This test shall be additionally performed on wired network ports (see clause 3.1), if any.

These tests shall be performed on a representative configuration of the radio equipment, the associated ancillary equipment, or a representative configuration of the combination of radio and ancillary equipment.

These tests assess the ability of the EUT to operate as intended in the event of surges present on the AC mains power input ports and wired network ports.

### 9.8.2 Test method

#### 9.8.2.0 General

The test method shall be in accordance with CENELEC EN 61000-4-5 [5], clauses 7 and 8.

The requirements and evaluation of test results given in clause 9.8.2.1 (wired network ports, outdoor cables), clause 9.8.2.2 (wired network ports, indoor cables) and clause 9.8.2.3 (mains ports) shall apply, but no test shall be required where normal functioning cannot be achieved, because of the impact of the CDN on the EUT.

#### 9.8.2.1 Test method for wired network ports directly connected to outdoor cables

The test level for symmetrically operated, wired network ports, intended to be directly connected to wired network ports via outdoor cables, shall be 1 kV (applied lines to ground) as given in CENELEC EN 61000-4-5 [5], clause 5. The test generator shall provide the 10/700  $\mu$ s pulse as defined in CENELEC EN 61000-4-5 [5], clause 6.2.

The test level for non-symmetrically operated wired network ports, intended to be directly connected to wired network ports via outdoor cables, shall be 1 kV (applied line to ground, or shield to ground) and 0,5 kV (applied line to line) as given in CENELEC EN 61000-4-5 [5], clause 5. The test generator shall provide the 1,2/50  $\mu$ s pulse as defined in CENELEC EN 61000-4-5 [5], clause 6.1.

The total output impedance of the surge generator shall be in accordance with the basic standard CENELEC EN 61000-4-5 [5], clauses 6.1 and 6.2.

### 9.8.2.2 Test method for wired network ports connected to indoor cables

The test level for wired network ports, intended to be connected to indoor cables (longer than 30 m) shall be 0,5 kV (applied line to ground, or shield to ground). In this case the total output impedance of the surge generator shall be in accordance with the basic standard CENELEC EN 61000-4-5 [5], clause 6.3. The test generator shall provide the 1,2/50  $\mu$ s pulse as defined in CENELEC EN 61000-4-5 [5], clause 6.1.

### 9.8.2.3 Test method for mains ports

The test level for AC mains power input ports shall be 2 kV line to ground, and 1 kV line to line, with the output impedance of the surge generator as given in CENELEC EN 61000-4-5 [5], clause 6.3.

In telecom centres 1 kV line to ground and 0,5 kV line to line shall be used.

The test generator shall provide the 1,2/50  $\mu$ s pulse as defined in CENELEC EN 61000-4-5 [5], clause 6.1.

## 9.8.3 Performance criteria

The performance criteria for transient phenomena shall apply (as specified in clause 6.2).

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

### A.1 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.16] 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 301 489-1 |   |                                     |                                   |                            |  |
|---------------------------------------|---|-------------------------------------|-----------------------------------|----------------------------|--|
| Requirement                           |   |                                     |                                   | Requirement Conditionality |  |
| No                                    | Description   | Essential requirements of Directive | Clause(s) of the present document | U/C                        | Condition  |
| 1                                     | Emissions: Enclosure of ancillary equipment                           | 3.1b                                | 8.2                               | C                          | Only applicable to ancillary equipment not incorporated in the radio equipment.  |
| 2                                     | Emissions: DC power input/output ports                                | 3.1b                                | 8.3                               | C                          | Only where equipment has DC power input and/or output ports with a cable length greater than 3 m or from a vehicle power supply. |
| 3                                     | Emissions: AC mains power input/output ports                          | 3.1b                                | 8.4                               | C                          | Only where equipment has AC mains power input and/or output ports.   |
| 4                                     | Emissions: Harmonic current emission (AC mains input port)            | 3.1b                                | 8.5                               | C                          | Only where equipment has AC mains power input ports.   |
| 5                                     | Emissions: Voltage fluctuations and flicker (AC mains input ports)    | 3.1b                                | 8.6                               | C                          | Only where equipment has AC mains power input ports.   |
| 6                                     | Emissions: Wired network ports  | 3.1b                                | 8.7                               | C                          | Only where equipment has wired network ports.  |
| 7                                     | Immunity: Radio frequency electromagnetic field (80 MHz to 6 000 MHz) | 3.1b                                | 9.2                               | U                          |  |
| 8                                     | Immunity: Electrostatic discharge                                     | 3.1b                                | 9.3                               | U                          |  |
| 9                                     | Immunity: Fast transients common mode                                 | 3.1b                                | 9.4                               | C                          | Applicable for equipment with AC mains power input ports.  |
| 10                                    | Immunity: Fast transients common mode                                 | 3.1b                                | 9.4                               | C                          | Applicable for equipment with DC power ports with cables longer than 3 m.  |
| 11                                    | Immunity: Fast transients common mode                                 | 3.1b                                | 9.4                               | C                          | Applicable for equipment with cable(s) longer than 3 m connected to signal, wired network, or control ports.                     |
| 12                                    | Immunity: Radio frequency common mode                                 | 3.1b                                | 9.5                               | C                          | Applicable for equipment with AC mains power input ports.  |
| 13                                    | Immunity: Radio frequency common mode                                 | 3.1b                                | 9.5                               | C                          | Applicable for equipment with DC power ports with cables longer than 3 m.  |
| 14                                    | Immunity: Radio frequency common mode                                 | 3.1b                                | 9.5                               | C                          | Applicable for equipment with cable(s) longer than 3 m connected to signal, wired network, or control ports.                     |

| Harmonised Standard ETSI EN 301 489-1 |  |                                     |                                   |                            |   |
|---------------------------------------|--|-------------------------------------|-----------------------------------|----------------------------|---|
| Requirement                           |  |                                     |                                   | Requirement Conditionality |   |
| No                                    | Description  | Essential requirements of Directive | Clause(s) of the present document | U/C                        | Condition   |
| 15                                    | Immunity: Transients and surges in the vehicular environment | 3.1b                                | 9.6                               | C                          | Only where equipment is connected to vehicle power supply.                      |
| 16                                    | Immunity: Voltage dips and interruptions                     | 3.1b                                | 9.7                               | C                          | Only where equipment has AC mains power input ports.                            |
| 17                                    | Immunity: Surges, line to line and line to ground            | 3.1b                                | 9.8                               | C                          | Only where equipment has AC mains power input ports and/or wired network 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.

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## Annex B (informative): Application of harmonised EMC standards to multi-radio and multi-standard-radio equipment

### B.1 Introduction

This clause details the additional considerations when dealing with multi-radio and multi-standard-radio equipment.

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### B.2 Multi-radio equipment capable of independent operation

If the individual radio equipment and their corresponding radio links operate independently in normal usage, then separate testing may be used. Where separate testing is performed the individual radio equipment should be assessed to the appropriate harmonised EMC standards.

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### B.3 Multi-radio equipment and multi-standard-radio equipment not capable of independent operation

However, where operation of the individual radio equipment and their corresponding radio links is simultaneous in normal usage, then separate testing should not be used. In this case testing should be performed on the complete radio equipment. An overall performance criteria is required for the radio equipment. This may be developed by examining the individual performance criteria of the various radio equipment involved. The performance criteria used should be recorded in the test report.

Where multiple operational frequencies are used, exclusion bands should be defined for each of the operating bands in use and all of these should be applied during testing.

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### B.4 Multi-radio equipment comprising of numerous identical radio transmitters

Typically this situation exists where a baseband amplifier is used to feed multiple radio front ends that may be located in a different location to the baseband amplifier. Where the individual parts are intended to be installed in different locations then the individual parts may be tested separately to the appropriate harmonised EMC standard applicable to each product part. Alternatively, where the individual parts are intended to be installed at the same location, then the individual parts should be tested together in a manner representative of their intended use.

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## Annex C (informative): Information required by the test laboratory

### C.1 Information to be supplied

The manufacturer should, at the time of submission of the equipment for test, supply the following information to be recorded in the test report:

- the intended use of the radio equipment which should be in accordance with the user documentation;
- the user control functions and stored data that are required for intended use and the method to be used to assess whether these have been lost after the EMC exposure;
- the type of modulation (also known as "normal test modulation"), the characteristics of the transmission used for testing (random bit stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;
- the ancillary equipment to be combined with the radio equipment for testing (where applicable);
- an exhaustive list of ports, with the maximum cable lengths allowed, classified as either power or telecommunication/signal/control. Power ports should further be classified as AC or DC power;
- the operating frequency band(s) over which the equipment is intended to operate;
- any equipment thermal limitation which prevents continuous testing of the EUT;
- the climatic environment(s) in which the equipment is intended to be used;
- the occupied bandwidth of the corresponding transmitter signal for non-channelized equipment.

If the present document is used to demonstrate presumption of conformity to European Directive 2014/53/EU [i.1] as a specific radio part of the standard could not be identified for a particular type of radio equipment, then the manufacturer should at the time of submission of the equipment for test, supply the following information to be recorded in the test report:

- test conditions, clause 4;
- the value of  $n$  used in clause 4.3 used to determine the exclusion bands;
- performance criteria, clause 6.

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## Annex D (informative): Bibliography

ETSI EG 203 336: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

CENELEC EN 55016-1-4 (2010) + A1 (2012): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Radiated disturbances".

ETSI TR 103 088: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Using the ETSI EN 301 489 series of EMC standards".

## Annex E (informative): Change history

| Version | Information about changes  |
|---------|--|
| 2.1.1   | <p>Compared with earlier versions that were cited under previous EU Directives, the following changes have been introduced:</p> <ul style="list-style-type: none"> <li>• Radiated immunity testing to a continuous sweep between 80 MHz and 6 000 MHz at 3 V/m, as opposed to the previous frequency range of 80 MHz to 1 000 MHz and 1 400 MHz to 2 700 MHz in earlier editions of the ETSI EN 301 489 series [i.13].</li> <li>• New derivations of exclusion bands more closely linked to the operational characteristics of the radio link(s) in the EUT. In many cases this has resulted in new exclusion bands in the individual parts of the ETSI EN 301 489 series [i.13].</li> <li>• Surge test method aligned with CENELEC EN 61000-4-5 [5].</li> <li>• Also with this version the previous annex B that dealt with aftermarket fitment of radio equipment into vehicles has been removed following the demise of the EU motor vehicle EMC Directive.</li> <li>• Those parts of annex C that covered combined equipment have been removed.</li> </ul> <p>The above changes impact all other parts of the ETSI EN 301 489 series [i.13]. More information regarding the changes between the different versions of the ETSI EN 301 489 series [i.13] may be found in ETSI TR 103 088 [i.9].</p> |
| 2.2.1   | <p>Correction of circular and generic references, performance criteria definitions and annex A according to the concerns raised by the EC RE-D Desk officer.</p> <p>Editorial and format changes to align standard with current drafting guidelines, including the addition of annex D. No technical parameters were changed in this revision.</p>   |

# History

| Document history |                |   |
|------------------|----------------|---|
| V1.2.1           | August 2000    | Publication   |
| V1.3.1           | September 2001 | Publication   |
| V1.4.1           | August 2002    | Publication   |
| V1.5.1           | November 2004  | Publication   |
| V1.6.1           | September 2005 | Publication   |
| V1.8.1           | April 2008     | Publication   |
| V1.9.2           | September 2011 | Publication   |
| V2.1.1           | February 2017  | Publication   |
| V2.2.0           | March 2017     | EN Approval Procedure AP 20170606: 2017-03-08 to 2017-06-06 |
| V2.2.1           | March 2019     | EN Approval Procedure AP 20190617: 2019-03-19 to 2019-06-17 |