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*Candidate Harmonized European Standard (Telecommunications series)*

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
ElectroMagnetic Compatibility (EMC)  
standard for radio equipment and services;  
Part 1: Common technical requirements**

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## Foreword

This Candidate Harmonized European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC [4] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC [2] as amended) and Directive 1999/5/EC [1] of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity ("the R&TTE Directive" [1]).

The present document is based upon the Generic Standards EN 61000-6-3 [5] and EN 61000-6-1 [6] and other standards, where appropriate, to meet the essential requirements of Council Directives 89/336/EEC [2], 1999/5/EC [1] and the motor vehicle EMC directive 95/54/EC [19] respectively.

The motor vehicle EMC directive 95/54/EC [19], is a type approval directive, and contains in its annexes, all the technical requirements necessary to demonstrate conformance. There are two categories of after market equipment covered by the directive as follows;

- a) After market (radio) equipment (and ancillary equipment) intended for installation in a motor vehicle, and which **are not related to immunity related functions** (annex 1, clause 2.1.12 of the directive) of the motor vehicle;
- b) After market (radio) equipment (and ancillary equipment) intended for installation in a motor vehicle, and which **is related to immunity related functions** (annex 1, clause 2.1.12) of the motor vehicle, are subject to **type approval requirements** of the directive 95/54/EC [19].

This standard only deals with equipment of category a) subject to the requirements set out below:

**Annex 1, clause 3.2.9 of 95/54/EC [19]**, sets out the acceptance of conformity according to the procedures of 89/336/EEC [2] or 1999/5/EC [1] for after market equipment (ESAs) not related to immunity related functions of the motor vehicle (annex 1, clause 2.1.12), but additionally requires that the ESA fulfils the limits defined in annex 1, clauses 6.5, 6.6, 6.8, and 6.9 of the directive. Requirements applicable to this type of after market equipment (ESAs) are set out in annex D of the present document.

The present document, and the product related parts of it are based on the current EMC standards published by ETSI. It should be noted that the majority of these EMC standards have also been published in the Official Journal of the European Commission.

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 40 GHz";

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

Part 5: "Specific conditions for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech)";

Part 6: "Specific conditions for Digital Enhanced Cordless Telecommunications (DECT) equipment";

Part 7: "Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)";

Part 8: "Specific conditions for GSM base stations";

Part 9: "Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio and in-ear monitoring devices";

Part 10: "Specific conditions for First (CT1 and CT1+) and Second Generation Cordless Telephone (CT2) equipment";

Part 11: "Specific conditions for terrestrial sound broadcasting service transmitters";

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 14: "Specific conditions for analogue and digital terrestrial TV broadcasting service transmitters";

Part 15: "Specific conditions for commercially available amateur radio equipment";

Part 16: "Specific conditions for analogue cellular radio communications equipment, mobile and portable";

Part 17: "Specific conditions for 2,4 GHz wideband transmission systems and 5 GHz high performance RLAN equipment";

Part 18: "Specific conditions for Terrestrial Trunked Radio (TETRA) equipment";

Part 19: "Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications";

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 23: "Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) Base Station (BS) radio, repeater and ancillary equipment";

Part 24: "Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment";

Part 25: "Specific conditions for CDMA 1x Spread Spectrum Mobile Stations and ancillary equipment";

Part 26: "Specific conditions for CDMA 1x spread spectrum Base Stations, repeaters and ancillary equipment".

Part 27: "Specific conditions for Ultra Low Power Active Medical Implants (ULP-AMI) and related peripheral devices (ULP-AMI-P)";

Part 28: "Specific conditions for wireless digital video links";

Part 31: "Specific conditions for equipment in the 9 to 315 kHz band for Ultra Low Power Active Medical Implants (ULP-AMI) and related peripheral devices (ULP-AMI-P)";

Part 32: "Specific conditions for Ground and Wall Probing Radar applications".

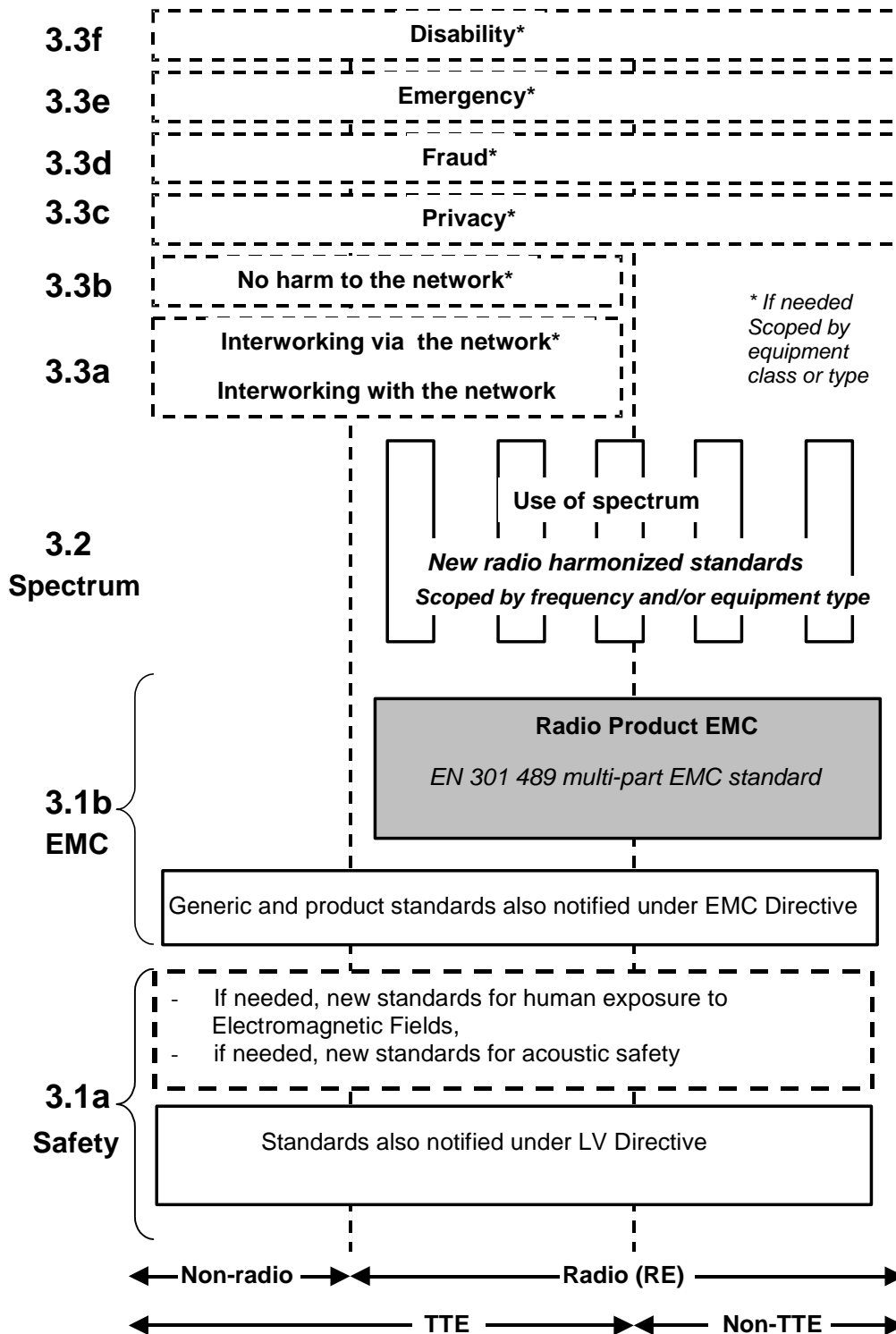
Technical specifications relevant to the EMC Directive [2] and the R&TTE Directive [1] are given in annex A.

<b>Proposed national transposition dates</b>	
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):	36 months after doa

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## Introduction

The present document is part of a set of standards designed to fit in a modular structure to cover all radio and telecommunications terminal equipment under the R&TTE Directive [1]. Each standard is a module in the structure. The modular structure is shown in figure 1.



**Figure 1: Modular structure for the various standards used under the R&TTE Directive**

The left hand edge of the figure 1 shows the different clauses of article 3 of the R&TTE Directive [1].

For article 3.3 various horizontal boxes are shown. Dotted lines indicate that at the time of publication of the present document essential requirements in these areas have to be adopted by the Commission. If such essential requirements are adopted, and as far and as long as they are applicable, they will justify individual standards whose scope is likely to be specified by function or interface type.

The vertical boxes show the standards under article 3.2 for the use of the radio spectrum by radio equipment. The scopes of these standards are specified either by frequency (normally in the case where frequency bands are harmonized) or by radio equipment type.



For article 3.1b the diagram shows EN 301 489, the multi-part product EMC standard for radio used under the EMC Directive [2].

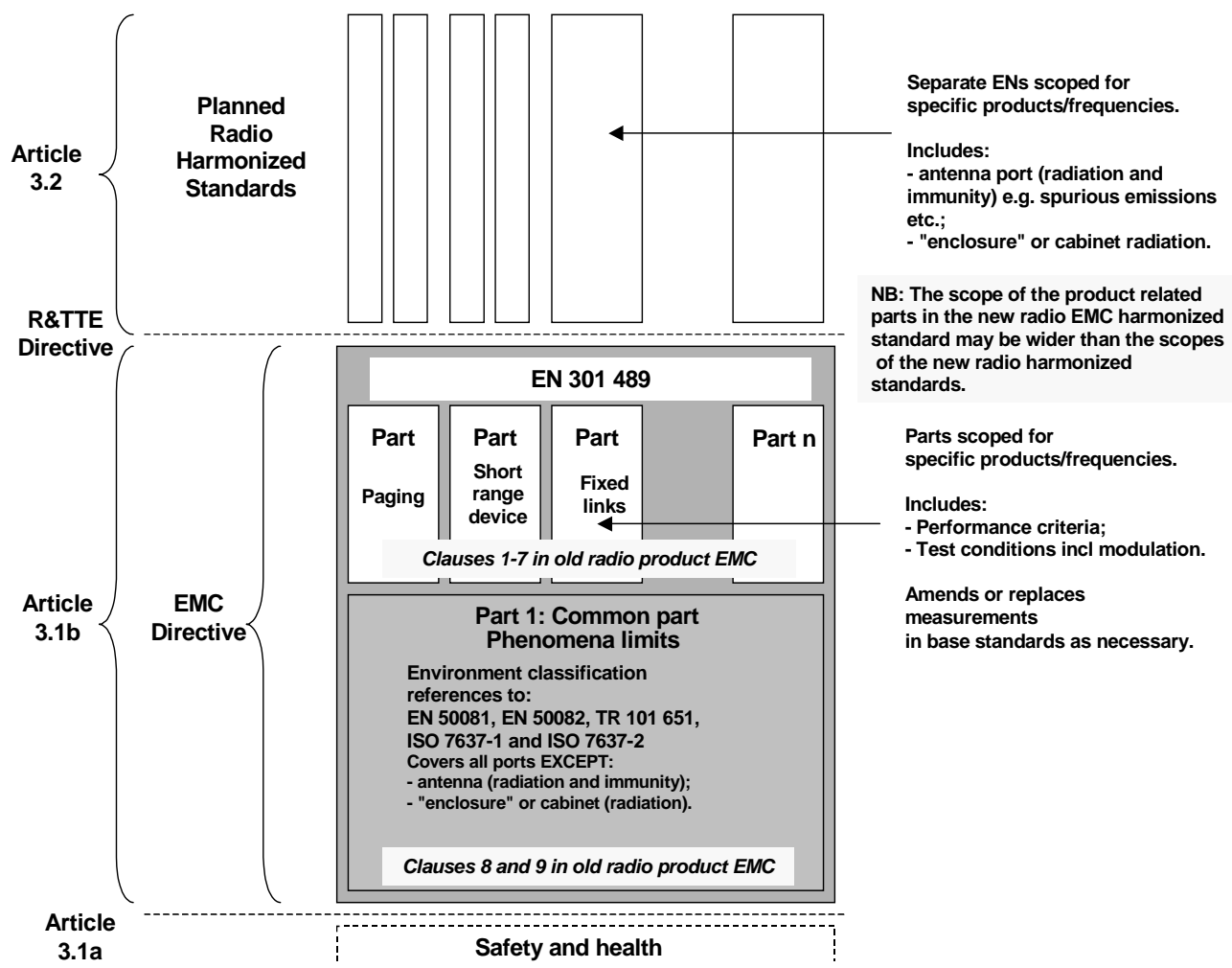
For article 3.1a the diagram shows the existing safety standards currently used under the LV Directive [3] and new standards covering human exposure to electromagnetic fields. New standards covering acoustic safety may also be required.

The bottom of the figure shows the relationship of the standards to radio equipment and telecommunications terminal equipment. A particular equipment may be radio equipment, telecommunications terminal equipment or both. A radio spectrum standard will apply if it is radio equipment. An article 3.3 standard will apply as well only if the relevant essential requirement under the R&TTE Directive [1] is adopted by the Commission and if the equipment in question is covered by the scope of the corresponding standard. Thus, depending on the nature of the equipment, the essential requirements under the R&TTE Directive [1] may be covered in a set of standards.

The modularity principle has been taken because:

- it minimizes the number of standards needed. Because equipment may, in fact, have multiple interfaces and functions it is not practicable to produce a single standard for each possible combination of functions that may occur in an equipment;
- it provides scope for standards to be added:
  - under article 3.2 when new frequency bands are agreed; or
  - under article 3.3 should the Commission take the necessary decisions without requiring alteration of standards that are already published;
  - it clarifies, simplifies and promotes the usage of Harmonized Standards as the relevant means of conformity assessment.

Figure 2 gives an enlargement of the EMC layer which is judged to be appropriate in view of the present document derivation.



**Figure 2: The new radio EMC harmonized standard**

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

- One EMC standard for all radio equipment made up of several parts.
- 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.

To demonstrate an adequate level of EMC protection, the present document is to be used together with the appropriate specific radio part of the standard.

It is recognized that there may be circumstances where none of the existing specific product related radio parts covers the required conditions for a particular radio equipment/service e.g. in case of the initial introduction of a new radio service or a special application. In this situation the present document can be used together with specific information for the radio equipment provided by the manufacturer, for the purposes of testing to the EMC requirements set out in the present document.

In all cases where a radio product falls within the scope of a specific product related radio part of the standard, the product related part takes precedence.

**Table 1: Void**

---

# 1 Scope

The present document contains the common requirements for radio communications equipment and associated ancillary equipment, in respect of ElectroMagnetic Compatibility (EMC).

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 product related parts of EN 301 489 series [22].

The present document, together with the product related part, specifies the applicable EMC tests, the methods of measurement, the limits and the performance criteria for radio equipment and associated ancillary equipment. In case of differences (for instance concerning special conditions, definitions, abbreviation) between this part and the relevant product related part of EN 301 489 series [22], the product related part takes precedence.

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.

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

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

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus intended to be used in the environments mentioned above. The levels, however, do not cover extreme cases which may occur in any location but with low probability of occurrence. The applicable environment(s) shall be declared by the manufacturer and shall be in accordance with the equipment documentation.

For radio equipment and associated ancillary equipment intended to be installed in motor vehicles (i.e. ESAs) and not related to immunity related functions of the vehicle, additional technical requirements necessary to demonstrate conformance to the motor vehicle EMC Directive 95/54/EC [19], are set out in annex D (normative) of the present document.

The present document may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomenon is permanently present, e.g. a radar or broadcast site in the near vicinity. In such a case it may be necessary to use special protection applied to either the source of interference or the interfered part or both.

Compliance of radio equipment to the requirements of the present document does not signify compliance to any requirements related to spectrum management or to the use of the equipment (licensing requirements).

Compliance to the requirements of the present document does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment to record in the test report any observations regarding the test sample becoming dangerous or unsafe as a result of the application of the tests called for in the present document.

NOTE: Radio equipment for use in maritime environment is covered by other ETSI EMC standards.

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## 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

- [1] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- [2] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
- [3] Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).
- [4] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.
- [5] CENELEC EN 61000-6-3 (2001): "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments".
- [6] CENELEC EN 61000-6-1 (2001): "Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments".
- [7] CENELEC EN 55022: "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".
- [8] CENELEC EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".
- [9] CENELEC EN 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".
- [10] CENELEC EN 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".
- [11] CENELEC EN 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test".
- [12] CENELEC EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields".
- [13] CENELEC EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".
- [14] ISO 7637-2 (2004): "Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only".
- [15] ETSI TR 101 651 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Classification of the electromagnetic environment conditions for equipment in telecommunication networks".

- [16] CENELEC EN 61000-3-2/Amendment 1 (2001): "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)".
- [17] CENELEC EN 61000-3-3 (1995): "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".
- [18] IEC 60050-161: "International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility".
- [19] Commission Directive 95/54/EC of 31 October 1995 adapting to technical progress Council Directive 72/245/EEC on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers.
- [20] CISPR 25 (2nd Edition 2002) : "Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices- Limits and methods of measurement".
- [21] CISPR 16-1 (2nd Edition 2002): "Specification for radio disturbance and immunity measuring apparatus and methods".
- [22] ETSI EN 301 489: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services".

## 3 Definitions and abbreviations

### 3.1 Definitions

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

**ancillary equipment:** equipment (apparatus), used in connection with a receiver or transmitter

NOTE: It is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction 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 equipment cannot be used on a stand alone basis 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).

**base station equipment:** radio and/or ancillary equipment intended for operation at a fixed location and powered directly or indirectly (e.g. via an AC/DC converter or power supply) by the AC mains network, or an extended local DC mains network

**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 [18].

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

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

**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

**host equipment:** any equipment which has a complete user functionality when not connected to a radio communications equipment, and to which this radio equipment provides additional functionality, and to which connection is necessary for this radio equipment to offer additional functionality, and in which the transceiver part of the radio equipment is physically installed

NOTE: This also covers any device that would accept a variety of radio modules, where the original user functionality of the host equipment is not affected.

**integral antenna:** antenna which may not be removed during the tests, according to the manufacturer's statement

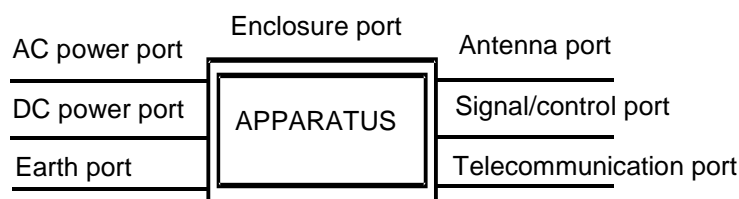
**manufacturer:** manufacturer of the equipment, or his authorized representative, or an equipment supplier to the European market

**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

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

**port:** particular interface, of the specified equipment (apparatus), 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.

**portable equipment:** radio and/or ancillary equipment intended for portable (e.g. handheld) operation, powered by its own integral battery

**radio communications equipment:** telecommunications equipment which includes one or more radio transmitters and/or receivers and/or parts thereof for use in a fixed, mobile or portable application

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 according to the manufacturer statement

**telecommunication port:** ports which are intended to be connected to telecommunication networks (e.g. public switched telecommunication networks, integrated services digital networks), local area networks (e.g. Ethernet, Token Ring) and similar networks

NOTE: See EN 55022 [7].

**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 [18].

## 3.2 Abbreviations

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

AC	Alternating Current
AMN	Artificial Mains Network
DC	Direct Current
EM	ElectroMagnetic
EMC	ElectroMagnetic Compatibility
ESA	electronic sub-assembly
EUT	Equipment Under Test
IF	Intermediate Frequency
ISN	Impedance Stabilization Network
RF	Radio Frequency
rms	root mean square

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## 4 Test conditions

### 4.1 General

The equipment shall be tested under normal test conditions according to the relevant product and basic standards or to the information accompanying the equipment, which are within the manufacturers declared range of humidity, temperature and supply voltage. The test conditions shall be recorded in the test report.

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

For emission and immunity tests, specific product related information on the test modulation, test conditions and tests arrangements, etc., are found in the part of EN 301 489 series [22] dealing with the particular type of radio equipment.

### 4.2 Arrangements for test signals

Adequate measures shall be taken to avoid the effect of immunity test signals on both the measuring equipment and the signal sources for the wanted signals located outside the test environment.

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

The signal source providing the transmitter under test with the modulation signal for the normal test modulation shall be located outside the test environment, unless the transmitter is modulated by its own internal source, see the relevant part of EN 301 489 series [22].

The transmitter shall be modulated with normal test modulation, by an internal or external signal source capable of delivering the normal test modulation as specified in the relevant part of EN 301 489 series [22].

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

The measuring equipment for the wanted RF output signal from the transmitter under test shall 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 measuring equipment by a coaxial cable.

For transmitters with a removable antenna, 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. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the transmission line at the point of entry to the transmitter.

Unless otherwise specified in the relevant part of EN 301 489 series [22] for the particular type of radio equipment, 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, modulated with the normal test modulation.

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

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

The signal source shall be modulated with normal test modulation as specified in the relevant part of EN 301 489 series [22] for the particular type of radio equipment.

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 a coaxial cable.

For receivers with a removable antenna, the wanted RF input signal to establish a communication link shall be presented to the antenna connector of the EUT by a shielded transmission line, such as a coaxial cable. The transmission line shall be connected to the external RF signal source. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the shielded transmission line at the point of entry to the receiver.

Unless otherwise specified in the part of EN 301 489 series [22] relevant for the particular type of radio equipment, the level of the wanted RF input signal shall be set to be approximately 40 dB above the minimum level necessary to achieve a receiver performance which meets the relevant specified performance criteria, measured while the power amplifiers generating the EM disturbance are switched on, but without excitation. This increased level of the wanted RF input signal is expected to represent a normal operation signal level and should be sufficient 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 shall be located outside the test environment.

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 shall be provided and recorded in the test report.

For receivers with a non-speech output the output signal shall be coupled via an electrically non-conductive means to the external measuring equipment outside the test environment (e.g. a camera to read a display). If the receiver has an output connector or port providing the wanted output signal, then this port shall be used via a cable, consistent with the standard cable used in normal operation, connected to the external measuring equipment outside the test environment. The measuring equipment may be supplied by the manufacturer.

Precautions shall be taken to ensure that any effect on the test due to the coupling means is minimized.

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

Transmitters and receivers may be tested for immunity as a system when combined as a transceiver or the combined equipment is of a size which allows simultaneous testing. In this case the transceiver or transmitter and receiver shall be located inside the test environment and shall be exposed simultaneously to the immunity test signals.

For transceivers or transmitters and receivers operating at the same frequency, the wanted output signal of the transmitter may be used via a suitable attenuator and applied to the input of the receiver as the wanted input signal.

For transceivers or transmitters and receivers operating at different frequencies in duplex mode the arrangements are defined in the product part of EN 301 489 series [22] relevant for the particular type of radio equipment.



### 4.3 RF exclusion band of radio communications equipment

The RF exclusion band applies to radio equipment with an operating frequency up to 2 GHz, or for equipment operating above 2 GHz, but whose RF bandwidth extends to a frequency below 2 GHz.

For equipment operating at frequencies above 2 GHz and whose RF bandwidth does not extend to a frequency below 2 GHz, there is no exclusion band.

This exclusion band is always product dependent and defined in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment.

### 4.4 Narrow band responses of receivers or receivers which are part of transceivers

Responses on receivers or the receiver part of (duplex) transceivers occurring during the immunity tests at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method.

If during the test the immunity RF test signal (see clauses 9.2 and 9.5) causes non-compliance of the receiver with the specified performance criteria (see clause 6), it is necessary to establish whether this non-compliance is due to a narrow band 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 if appropriate, the bandwidth over which the apparatus is intended to operate, as declared by the manufacturer. 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 a narrow band response.

If the receiver still does not comply with the specified performance criteria, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band 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, narrow band responses shall be disregarded.

Particular performance criteria typical for the relevant type of EUT and information about any product type dependent nominal frequency offset to be used for the identification of narrowband responses can be found in the part of EN 301 489 series [22] dealing with the particular type of radio equipment.

Where no narrow band responses of receivers are permitted, this shall be stated within the part of EN 301 489 series [22] dealing with particular type of radio equipment.

### 4.5 Normal test modulation

For the purpose of EMC tests, the transmitter under test shall be modulated according to the normal test modulation specified in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment.

For the purpose of EMC tests, the receiver under test shall be provided with a wanted RF input signal modulated according to the normal test modulation specified in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment.

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## 5 Performance assessment

### 5.1 General

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

- the primary functions of the radio equipment to be assessed during and after the EMC exposure;
- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;
- the user control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after the EMC exposure;
- the type of 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 shall further be classified as AC or DC power;
- the bandwidth of the IF filter immediately preceding the demodulator;
- the method to be used to verify that a communication link is established and maintained (if appropriate);
- the operating frequency bands over which the equipment is intended to operate;
- any equipment thermal limitation which prevent continuous testing of the EUT;
- the environment(s) in which the equipment is intended to be used.

If additional product related information is required, these can be found in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment.

If the present document is used on a stand alone basis to demonstrate presumption of conformity to European Directive 1999/5/EC [1] as a specific radio part of the standard could not be identified for a particular type of radio equipment, then the manufacturer shall 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;
- performance assessment, clause 5;
- performance criteria, clause 6.

### 5.2 Equipment which can provide a continuous communication link

For radio equipment of non-specialized nature or for radio equipment tested in combination with ancillary equipment, the normal test modulation, test arrangements, etc., shall apply.

### 5.3 Equipment which does not provide a continuous communication link

For radio equipment which does not provide a continuous communication link and/or ancillary equipment intended to be tested on a stand-alone basis, the manufacturer shall specify the permissible minimum level of performance or degradation of performance during and/or after the EMC exposure.

The manufacturer shall furthermore define the test method(s) for the assessment of the actual level of performance or degradation of performance during and/or after the EMC exposure. Under these circumstances the manufacturer shall additionally provide the following information also for inclusion in the test report:

- the primary functions of the relevant type of the EUT during and after EMC stress;
- the intended functions of the relevant type of the EUT which shall be in accordance with the documentation accompanying the equipment;
- suitable pass/fail criteria for the relevant type of the EUT;
- the method of monitoring the actual level of performance and/or the actual degradation of performance of the EUT.

The assessment of the actual performance or its degradation which is carried out during and/or after the EMC exposure, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

## 5.4 Ancillary equipment

At the manufacturer's discretion ancillary equipment may be tested and assessed:

- applying the provisions of the present document:
  - separately to the ancillary equipment; or
  - to the combination of ancillary and radio equipment;
- applying another appropriate EMC standard.

In each case, compliance enables the ancillary equipment to be used with different receivers, transmitters or transceivers.

## 5.5 Equipment classification

For the purpose of the EMC performance assessment in the present document, the radio equipment and/or associated ancillary equipment under test shall be classified into one of the following three classes:

- equipment for fixed use (e.g. base station equipment); or
- equipment for vehicular use (e.g. mobile equipment); or
- equipment for portable use (portable equipment);

taking into account the definitions in clause 3.1.

This classification determines the extent of applicable EMC tests. However, the following instructions shall also apply to multiple use radio and/or ancillary equipment:

- radio and/or ancillary equipment for portable use or combinations thereof declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as equipment for vehicular use;
- radio and/or ancillary equipment for portable or vehicular use or combinations thereof declared as capable of being powered for intended use by an AC mains or DC network shall additionally be considered as equipment for fixed use.

Subsequently, for multiple use radio and/or ancillary equipment more than one set of equipment test requirements listed in tables 2 and 3 has to be taken into account.

Additionally radio equipment when integrated within a host equipment shall meet the requirements of the present document.

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## 6 Performance criteria

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 four categories of performance criteria apply:

- performance criteria for continuous phenomena applied to transmitters;
- performance criteria for transient phenomena applied to transmitters;
- performance criteria for continuous phenomena applied to receivers;
- performance criteria for transient phenomena applied to receivers.

Normally, the performance criteria depend on the type of radio equipment. Thus, the present document only contains general performance criteria commonly used for the assessment of radio equipment. More specific and product-related performance criteria for a dedicated type of radio equipment may be found in the part of EN 301 489 series [22] dealing with the particular type of radio equipment.

### 6.1 Performance criteria for continuous phenomena applied to transmitters and receivers

If no further details are given in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment, the following general performance criteria for continuous phenomena shall apply.

During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

### 6.2 Performance criteria for transient phenomena applied to transmitters and receivers

If no further details are given in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment, the following general performance criteria for transient phenomena shall apply.

After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

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

For radio equipment which does not provide a continuous communication link, the performance criteria described in clauses 6.1 and 6.2 are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation. The related specifications set out in clause 5.3 have also to be taken into account.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in clauses 6.1 and 6.2.

## 6.4 Performance criteria for ancillary equipment tested on a stand alone basis

If ancillary equipment is intended to be tested on a stand alone basis, the performance criteria described in clauses 6.1 and 6.2 are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation. The related specifications set out in clause 5.3 have also to be taken into account.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in clauses 6.1 and 6.2.

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# 7 Applicability overview tables

The applicability overview (tables 2 and 3) give a comprehensive overview about all EMC tests specified in the present document for radio and/or associated ancillary equipment.

The applicability of EMC tests specified in the present document depends on the actual type of radio and/or associated ancillary equipment under test. All tests are port-related EMC tests. For a certain type of EUT not having a particular type of port or for operational/technical reasons, the related EMC tests may not apply. In these cases, clause 7 of the part of EN 301 489 series [22] dealing with the particular type of radio equipment provides specifications or restrictions to the applicability of EMC tests for the actual type of EUT. In the case that the present document is used in a stand-alone basis it is required that both the decision and the justification not to apply any particular test to any particular port be recorded in the test report.

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

## 7.1 EMC emission

**Table 2: EMC emission measurements for radio and associated ancillary equipment specified in the present document, overview**

Phenomenon	Application	Equipment test requirement			Reference clause in the present document
		Radio and ancillary equipment for fixed use (e.g. base station equipment)	Radio and ancillary equipment for vehicular use (e.g. mobile equipment)	Radio and ancillary equipment for portable use (portable equipment)	
radiated emission	enclosure of ancillary equipment	applicable for stand alone testing	applicable for stand alone testing	applicable for stand alone testing	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

Phenomenon	Application	Equipment test requirement			Reference clause in the present document
		Radio and ancillary equipment for fixed use (e.g. base station equipment)	Radio and ancillary equipment for vehicular use (e.g. mobile equipment)	Radio and ancillary equipment for portable use (portable equipment)	
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	telecommunication port	applicable	not applicable	not applicable	8.7

## 7.2 Immunity

**Table 3: Immunity tests for radio and associated ancillary equipment specified in the present document, overview**

Phenomenon	Application	Equipment test requirement			Reference clause in the present document
		Radio and ancillary equipment for fixed use (e.g. base station equipment)	Radio and ancillary equipment for vehicular use (e.g. mobile equipment)	Radio and ancillary equipment for portable use (portable equipment)	
RF electromagnetic field (80 MHz to 1 000 MHz and 1 400 MHz to 2 000 MHz)	enclosure	applicable	applicable	applicable	9.2
electrostatic discharge	enclosure	applicable	applicable	applicable	9.3
fast transients common mode	signal, telecommunication 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, telecommunication and control ports, DC and AC power ports	applicable	applicable	not applicable	9.5
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, telecommunication ports	applicable	not applicable	not applicable	9.8

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## 8 Methods of measurement and limits for EMC emissions

### 8.1 Test configuration

This clause defines the requirements for test configurations:

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- the equipment shall be configured in a manner which is representative for normal/typical operation, where practical;
- where radio equipment is provided with an integral antenna, it shall be tested with the antenna fitted in a manner typical of normal intended use, unless declared as a removable antenna;
- 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 termination are covered;
- ports, which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- the configuration and mode of operation during the measurements shall be precisely noted in the test report.

### 8.2 Enclosure of ancillary equipment measured on a stand alone basis

This test is only applicable to ancillary equipment not incorporated in the radio equipment and intended to be measured on a stand-alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the ancillary equipment.

This test is not applicable for ancillary equipment incorporated in the radio equipment, or for ancillary equipment intended to be measured in combination with the radio equipment. In these cases the requirements of the relevant product standard for the effective use of the radio spectrum shall apply.

Product related conditions for combined testing of radio and ancillary equipment may be contained in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment.

#### 8.2.1 Definition

This test assesses the ability of ancillary equipment to limit their internal noise from being radiated from the enclosure.

#### 8.2.2 Test method

The test method shall be in accordance with EN 55022 [7].

### 8.2.3 Limits

The ancillary equipment shall meet the limits according to EN 55022 [7] (10 m measuring distance) shown in table 4.

**Table 4: Limits for radiated emissions from ancillary equipment, measured on a stand-alone basis**

Frequency range	Limit (quasi-peak)
30 MHz to 230 MHz	30 dB $\mu$ V/m
> 230 MHz to 1 000 MHz	37 dB $\mu$ V/m

Alternatively, for ancillary equipment intended to be used in telecommunication centres only, the limits given in table 5 (10 m measuring distance) can be used.

**Table 5: Limits for radiated emissions from ancillary equipment intended for use in telecommunication centres only, and measured on a stand alone basis**

Frequency range	Limit (quasi-peak)
30 MHz to 230 MHz	40 dB $\mu$ V/m
> 230 MHz to 1 000 MHz	47 dB $\mu$ V/m

## 8.3 DC power input/output ports

This test is applicable for radio equipment and ancillary equipment for fixed use that may have DC cables longer than 3 m (see clause 5.1 - manufacturer's declaration).

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.

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.

### 8.3.1 Definition

This test assesses the ability of the EUT to limit its internal noise from being present on the DC power input/output ports.

### 8.3.2 Test method

The test method shall be in accordance with EN 55022 [7] and the Artificial Mains Networks (AMN) shall be connected to a DC 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 DC output ports the relevant port shall be connected via an AMN 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 according to EN 55022 [7], shown in table 6.

**Table 6: Limits for conducted emissions**

Frequency range	Limit (quasi-peak)	Limit (average)
0,15 MHz to 0,5 MHz	66 dB $\mu$ V – 56 dB $\mu$ V	56 dB $\mu$ V - 46 dB $\mu$ V
> 0,5 MHz to 5 MHz	56 dB $\mu$ V	46 dB $\mu$ V
> 5 MHz to 30 MHz	60 dB $\mu$ V	50 dB $\mu$ V

NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in table 7 may be used.

**Table 7: Limits for conducted emissions of equipment intended to be used in telecommunication centres only**

Frequency range	Limit (quasi-peak)	Limit (average)
0,15 MHz to 0,5 MHz	79 dB $\mu$ V	66 dB $\mu$ V
> 0,5 MHz to 30 MHz	73 dB $\mu$ V	60 dB $\mu$ V

## 8.4 AC mains power input/output ports

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.

### 8.4.1 Definition

This test assesses the ability of the EUT to limit its internal noise from being present on the AC mains power input/output ports.

### 8.4.2 Test method

The test method shall be in accordance with EN 55022 [7] 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

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.

The equipment shall meet the limits according to EN 55022 [7], shown in table 8.

**Table 8: Limits for conducted emissions**

Frequency range	Limit (quasi-peak)	Limit (average)
0,15 MHz to 0,5 MHz	66 dB $\mu$ V – 56 dB $\mu$ V	56 dB $\mu$ V - 46 dB $\mu$ V
> 0,5 MHz to 5 MHz	56 dB $\mu$ V	46 dB $\mu$ V
> 5 MHz to 30 MHz	60 dB $\mu$ V	50 dB $\mu$ V

NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in table 9 may be used.

**Table 9: Limits for conducted emissions of equipment intended to be used in telecommunication centres only**

Frequency range	Limit (quasi-peak)	Limit (average)
> 0,15 MHz to 0,5 MHz	79 dB $\mu$ V	66 dB $\mu$ V
> 0,5 MHz to 30 MHz	73 dB $\mu$ V	60 dB $\mu$ V

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

The appropriate requirements of EN 61000-3-2/A1 [16] for harmonic current emission apply for equipment covered by the scope of the present document with an input current up to and including 16A per phase.

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

The appropriate requirements of EN 61000-3-3 [17] for voltage fluctuations and flicker apply for equipment covered by the scope of the present document with an input current up to and including 16A per phase.

## 8.7 Telecommunication ports

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

### 8.7.1 Definition

This test assesses the EUT unwanted emission present at the telecommunication ports.

### 8.7.2 Test method

The test method shall be in accordance with EN 55022 [7].

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 telecommunication ports shall meet the limits according to EN 55022 [7] shown in table 10.

**Table 10: Limits for conducted emissions from telecommunication ports**

Frequency range	Voltage limits		Current limits	
	Quasi-peak	Average	Quasi-peak	Average
0,15 MHz to 0,5 MHz	84 dB $\mu$ V to 74 dB $\mu$ V	74 dB $\mu$ V to 64 dB $\mu$ V	40 dB $\mu$ A to 30 dB $\mu$ A	30 dB $\mu$ A to 20 dB $\mu$ A
0,5 MHz to 30 MHz	74 dB $\mu$ V	64 dB $\mu$ V	30 dB $\mu$ A	20 dB $\mu$ A
NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.				
NOTE 2: The current and voltage disturbance limits are derived for use with an Impedance Stabilization Network (ISN) which presents a common mode (asymmetric mode) impedance of 150 $\Omega$ to the telecommunication port under test (conversion factor is $20 \log_{10} 150/I = 44$ dB).				
NOTE 3: The emission requirement only applies to telecommunication ports as specified in EN 55022 [7]. The provisional relaxation of 10 dB will be reviewed no later than 3 years after the date of withdrawal based on the results and interference cases seen in this period. Wherever possible it is recommended to comply with the limits without the provisional relaxation.				

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in table 11 may be used.

**Table 11: Limits for conducted emissions from telecommunication ports of equipment intended for use in telecommunication centres only**

Frequency range	Voltage limits		Current limits	
	Quasi-peak	Average	Quasi-peak	Average
0,15 MHz to 0,5 MHz	97 dB $\mu$ V to 87 dB $\mu$ V	84 dB $\mu$ V to 74 dB $\mu$ V	53 dB $\mu$ A to 43 dB $\mu$ A	40 dB $\mu$ A to 30 dB $\mu$ A
0,5 MHz to 30 MHz	87 dB $\mu$ V	74 dB $\mu$ V	43 dB $\mu$ A	30 dB $\mu$ A
NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.				
NOTE 2: The current and voltage disturbance limits are derived for use with an Impedance Stabilization Network (ISN), which presents a common mode (asymmetric mode) impedance of 150 $\Omega$ to the telecommunication port under test (conversion factor is $20 \log_{10} 150/I = 44$ dB).				

## 9 Test methods and levels for immunity tests

### 9.1 Test configuration

This clause defines the requirements for test configurations:

- the tests shall be made in the mode(s) of operation specified in clause 4 in the relevant part of the EN 301 489 series [22] dealing with the particular type of radio equipment;
- the tests shall be carried out at a point within the specified normal operating 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 typical of normal intended use, unless declared as a removable antenna;
- 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, which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- ports which are not connected to cables during normal intended operation, 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 precisely noted in the test report.

## 9.2 Radio frequency electromagnetic field (80 MHz to 1 000 MHz and 1 400 MHz to 2 000 MHz)

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.

### 9.2.1 Definition

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 EN 61000-4-3 [9].

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 1 000 MHz and 1 400 MHz to 2 000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers (see clause 4), as appropriate;
- for receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency, unless specified otherwise in the part of EN 301 489 series [22] dealing with the relevant type of radio equipment;
- further product related spot frequency tests may be specified in the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment;
- responses on receivers occurring at discrete frequencies, which are narrow band responses, shall be disregarded from the test (see clause 4);
- the frequencies selected and used during the test shall be recorded in the test report.

### 9.2.3 Performance criteria

For transmitters the performance criteria for continuous phenomena for transmitters shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For receivers the performance criteria for continuous phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

## 9.3 Electrostatic discharge

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.

### 9.3.1 Definition

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 EN 61000-4-2 [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 4 kV and for air discharge 8 kV. All other details, including intermediate test levels, are contained within EN 61000-4-2 [8].

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 (see EN 61000-4-2 [8]).

### 9.3.3 Performance criteria

For transmitters the performance criteria for transient phenomena for transmitter shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For receivers the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

## 9.4 Fast transients, common mode

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, telecommunication 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 the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of 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 or a representative configuration of the combination of radio and ancillary equipment.

### 9.4.1 Definition

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 EN 61000-4-4 [10].

The following requirements and evaluation of test results shall apply:

- the test level for signal ports, telecommunication ports, and control ports shall be 0,5 kV open circuit voltage as given in EN 61000-4-4 [10];
- the test level for DC power input ports shall be 0,5 kV open circuit voltage as given EN 61000-4-4 [10];
- the test level for AC mains power input ports shall be 1 kV open circuit voltage as given EN 61000-4-4 [10].

## 9.4.3 Performance criteria

For transmitters the performance criteria for transient phenomena for transmitter shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of the radio equipment).

For receivers the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of the radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria shall apply.

## 9.5 Radio frequency, common mode

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, telecommunication 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 the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of 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.

### 9.5.1 Definition

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

### 9.5.2 Test method

The test method shall be in accordance with EN 61000-4-6 [12].

The following requirements and evaluation of test results shall apply:

- the test level shall be severity level 2 as given in EN 61000-4-6 [12] 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, unless specified otherwise in the part of EN 301 489 series [22] dealing with the particular type of radio equipment;
- the injection method to be used shall be selected according to the basic standard EN 61000-4-6 [12];

- responses on receivers or receiver parts of transceivers occurring at discrete frequencies which are narrow band responses (spurious responses), are disregarded from the test, (see clause 4);
- 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

For transmitters the performance criteria for continuous phenomena for transmitter shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For receivers the performance criteria for continuous phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with receivers or transmitters in which case the corresponding performance criteria above shall apply.

## 9.6 Transients and surges in the vehicular environment

These tests are applicable to radio and ancillary equipment intended for vehicular use (i.e. for mobile equipment).

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.

### 9.6.1 Definition

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 [14] for 12V DC and 24V DC powered equipment.

#### 9.6.2.1 Test requirements for 12 V and 24V DC powered equipment

The test method shall be in accordance with ISO 7636-2 [14], applying pulses 1, 2a, 2b, 3a, 3b, and 4, using immunity test level III.

### 9.6.3 Performance criteria

For transmitters pulse 3a and 3b the performance criteria for continuous phenomena for transmitters shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For pulse 1, 2a, 2b, 3a, 3b, and 4 the performance criteria for transient phenomena for transmitter shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment), with the exception that a communication link need not to be maintained during the EMC exposure and may have to be re-established.

For receivers pulse 3a and 3b the performance criteria for continuous phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For pulse 1, 2a, 2b, 3a, 3b, and 4 the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment), with the exception that a communication link need not to be maintained during the EMC exposure and may have to be re-established.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with the radio equipment in which case the corresponding performance criteria above shall apply.

## 9.7 Voltage dips and interruptions

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.

### 9.7.1 Definition

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 EN 61000-4-11 [13].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms; and
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms; and
- a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 000 ms.

### 9.7.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the following performance criteria apply:

- for transmitters the performance criteria for transient phenomena for transmitter shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment);
- for receivers the performance criteria for transient phenomena for receiver shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment);
- for ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms and/or a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 000 ms 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 for transmitters or for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment);
- 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;



- for ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

## 9.8 Surges

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 telecommunication 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.

### 9.8.1 Definition

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 telecommunication ports.

### 9.8.2 Test method

The test method shall be in accordance with EN 61000-4-5 [11]

The requirements and evaluation of test results given in clause 9.8.2.1 (telecommunication ports, outdoor cables), clause 9.8.2.2 (telecommunication 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 telecommunication ports directly connected to outdoor cables

The test level for telecommunications ports, intended to be directly connected to the telecommunications network via outdoor cables, shall be 1 kV line to ground as given in EN 61000-4-5 [11], however, in telecommunications centres 0,5 kV line to ground shall be used. In this case the total output impedance of the surge generator shall be in accordance with the basic standard EN 61000-4-5 [11].

The test generator shall provide the 1,2/50  $\mu$ s pulse as defined in EN 61000-4-5 [11].

#### 9.8.2.2 Test method for telecommunication ports connected to indoor cables

The test level for telecommunication ports, intended to be connected to indoor cables (longer than 10 m) shall be 0,5 Kv line to ground. In this case the total output impedance of the surge generator shall be in accordance with the basic standard EN 61000-4-5 [11].

The test generator shall provide the 1,2/50  $\mu$ s pulse as defined in EN 61000-4-5 [11].

#### 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 EN 61000-4-5 [11].

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 EN 61000-4-5 [11].

### 9.8.3 Performance criteria

For transmitters the performance criteria for transient phenomena for transmitters shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For receivers the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of EN 301 489 series [22] dealing with the particular type of radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 6.4) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

## Annex A (normative): Clauses of the present document relevant for compliance with the essential requirements of EC Council Directives

**Table A.1: Clauses of the present document relevant for compliance  
with the essential requirements of EC Council Directives**

Clause number and title		Corresponding article of Council Directive 89/336/EEC [2]	Corresponding article of Council Directive 1999/5/EC [1]	Corresponding article of Council Directive 95/54/EC [19]
8	Methods of measurement and limits for EMC emissions			
8.2	Enclosure of ancillary equipment measured on a stand alone basis	4 (a)	3.1 (b)	6.6 in Annex I
8.3	DC power input/output ports	4 (a)	3.1 (b)	
8.3	DC power input ports			6.9 in Annex I
8.4	AC mains power input/output ports	4 (a)	3.1 (b)	
8.5	Harmonic current emission (AC mains input port)	4 (a)	3.1 (b)	
8.6	Voltage fluctuations and flicker (AC mains input ports)	4 (a)	3.1 (b)	
8.7	Telecommunication ports	4 (a)	3.1 (b)	
9	Test methods and levels for immunity tests			
9.2	Radio frequency electromagnetic field (80 MHz to 1 000 MHz and 1 400 MHz to 2 000 MHz)	4 (b)	3.1 (b)	
9.3	Electrostatic discharge	4 (b)	3.1 (b)	
9.4	Fast transients common mode	4 (b)	3.1 (b)	
9.5	Radio frequency common mode	4 (b)	3.1 (b)	
9.6	Transients and surges in the vehicular environment	4 (b)	3.1 (b)	6.8 in Annex I
9.7	Voltage dips and interruptions	4 (b)	3.1 (b)	
9.8	Surges, line to line and line to ground	4 (b)	3.1 (b)	
C.2.1	Broadband electromagnetic interference (emissions) generated by the ESA			6.5 in Annex I
C.2.2	Narrow-band electromagnetic interference (emissions) generated by the ESA			6.6 in Annex I
C.2.3	Immunity of the ESA to transient disturbances conducted along the supply lines			6.8 in Annex I
C.2.4	Conducted disturbances (emissions) caused by the ESA			6.9 in Annex I

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## Annex B (informative): Bibliography

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 per phase and subject to conditional connection".

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## Annex C (informative): The EN title in the official languages

Language	EN title
Czech	
Danish	
Dutch	
English	
Estonian	
Finnish	
French	
German	
Greek	
Hungarian	
Icelandic	
Italian	
Latvian	
Lithuanian	
Maltese	
Polish	
Portuguese	
Slovak	
Slovenian	
Spanish	

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## Annex D (Normative):

Technical requirements for after market equipment (ESAs), which are not related to immunity related functions of the vehicle, necessary to demonstrate conformance to the motor vehicle EMC directive 95/54/EC

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### D.1 General

The annex numbers and clause numbers used are taken directly from directive 95/54/EC [19].

When reference is made to a clause number in the present document, this will be followed by the term "present document". The requirements of the tests set out below are in summary form, for full details, the directive 95/54/EC [19] and the reference documents quoted shall be used.

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### D.2 Technical requirements for radio equipment

#### D.2.1 Broadband electromagnetic interference (emissions) generated by the ESA

The provisions for broadband electromagnetic interferences are found in annex 1, clause 6.5. The method of measurement is described in annex VII.

The tests shall normally be performed according to CISPR 25 [20], clause 11 in an absorber lined shielded enclosure (ALSE). As an alternative an open area test site (OATS), which complies with the requirements of CISPR 16-1 [21] may be used.

The ESA shall be tested in normal operation mode.

The limit values are set out in annex 1, clause 6.5.2.1.

The test applies to broadband emissions of ESAs that are defined as follows:

2.1.5. "Broadband emission" means an emission, which has a bandwidth greater than that of a particular measuring apparatus or receiver (International Special Committee on Radio Interference (CISPR) 25, 2nd edition).

Radio equipment and many types of its associated ancillary equipment does not generate broadband emission in the meaning of this definition 2.1.5 in annex I of directive 95/54/EC [19]. There is no need to perform the test set out above.

#### D.2.2 Narrow-band electromagnetic interference (emissions) generated by the ESA

The provisions for narrow-band electromagnetic interferences are found in annex 1, clause 6.6. The method of measurement is described in annex VIII.

The tests shall normally be performed according to CISPR 25 [20], clause 11 in an absorber lined shielded chamber (ALSE). As an alternative an open area test site (OATS), which complies with the requirements of CISPR 16-1 [21] may be used.

The ESA shall be tested in normal operation mode.

The limit values are set out in annex 1, clause 6.6.2.1.

The test applies to narrow-band emissions of ESAs that are defined as follows:

2.1.6. "Narrowband emission" means an emission which has a bandwidth less than that of a particular measuring apparatus or receiver (CISPR 25[20]).

Radio equipment and its associated ancillary equipment may generate narrow-band emission (spurious emission) in the meaning of this definition 2.1.6 in annex I of directive 95/54/EC [19].

### D.2.2.1 Narrow-band spurious emissions of RF transmitters

For RF transmitters, it is not necessary to perform this test if the provisions of annex 1, clause 8.7 are met. This clause reads as follows:

"RF transmitters shall be tested in the transmit mode. Wanted emissions (e.g. from RF transmitting systems) within the necessary bandwidth and out of band emissions are disregarded for the purpose of this directive. Spurious emissions are subject to this directive, but need not be tested if the transmitter has a Declaration of Conformity according to Directive 1999/5/EC [1] using a harmonized standard."

The harmonized standards which contain the above requirements are those published in the European Commission, Official Journal, under the R&TTE Directive [1], and are used to demonstrate conformity to article 3.2 of this directive.

### D.2.2.2 Narrow-band spurious emissions of transceivers in stand by mode and receivers

It is not necessary to perform this test if the requirements set out in the harmonized radio standards of ETSI used to demonstrate conformity to article 3.2 of the R&TTE directive are met.

### D.2.2.3 Narrow-band spurious emissions of ancillary equipment

For ancillary equipment tested on a stand alone basis according to clause 8.2 of the present document, the provisions of annex 1, clause 6.6 are deemed to be fulfilled.

## D.2.3 Immunity of the ESA to transient disturbances conducted along the supply lines

The provisions for the immunity of ESAs to transient disturbances conducted along the supply lines are found in annex 1, clause 6.8. The test method is described in annex X.

The test is performed according to ISO 7637-2 [14], applying the test pulses 1, 2a, 2b, 3a, 3b, and 4 to the supply lines as well as to other connections of ESAs which may be operationally connected to supply lines.

Radio equipment and its associated ancillary equipment may be affected by such transient disturbances. Immunity tests are found in clause 9.6 of the present document.

## D.2.4 Conducted disturbances (emissions) caused by the ESA

The provisions for conducted disturbances from ESAs are found in annex 1, clause 6.9. The test method is described in annex X.

The measurement is performed according to ISO 7637-2 [14] on the supply lines as well as other connections of the ESAs which may be operationally connected to supply lines.

For radio and its associated ancillary equipment, it is not necessary to perform this test if the provisions of annex 1, clause 8.5 are met. This clause reads as follows:

8.5. "Conducted emission".

ESAs that are not switched, contain no switches or do not include inductive loads need not be tested for conducted emission and shall be deemed to comply with paragraph 6.9 of Annex I."



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## History

<b>Document history</b>			
V1.6.1	December 2004	Public Enquiry	PE 20050408: 2004-12-08 to 2005-04-08