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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 the 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 the Council Directive 98/34/EC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulation.

The present document is intended to become a Harmonized EMC 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 [3] as amended), and the Council Directive on the approximation of the laws of the Member States relating to radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (the "R&TTE Directive" 1999/5/EC [4]).

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

The present document is based upon the Generic Standards EN 50081-1 [1] and EN 50082-1 [2] and other standards, where appropriate, to meet the essential requirements of Council Directives 89/336/EEC [3], and 1999/5/EC [4] respectively.

For radio communications equipment which can be connected to the AC main supply, the requirements of EN 61000-3-2 [16] and EN 61000-3-3 [17] apply where appropriate from 1-1-2001.

The present document, and the product related parts of it is 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 EN covering the ElectroMagnetic Compatibility (EMC) standard for radio equipment and services, as identified below:

- Part 1: "Common technical requirements";**
- Part 2: "Specific requirements for radio paging equipment";
- Part 3: "Specific requirements for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 25 GHz";
- Part 4: "Specific requirements for fixed radio links and ancillary equipment and services";
- Part 5: "Specific requirements for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech)".

It is planned to prepare drafts structured in the same manner as the parts of the present documents mentioned above for the remainder of the current ETSI EMC standards for radio equipment by January 2000. This programme relates to the following existing standards:

- Part 6: **ETS 300 329**: EMC for Digital Enhanced Cordless Telecommunications (**DECT**) equipment;
- Part 7: **EN 300 342-1**: EMC for European digital cellular telecommunication systems (**GSM 900 MHz** and **DCS 1800 MHz**); Part 1: Mobile and portable radio and ancillary equipment;
- Part 8: **ETS 300 342-3**: EMC for European digital cellular telecommunications systems (**GSM 900 MHz** and **DCS 1800 MHz**); Part 3: Base station radio and ancillary equipment and repeaters meeting Phase 2 GSM requirements;
- Part 9: **ETS 300 445**: EMC standard for **wireless microphones** and similar **RF audio link** equipment;
- Part 10: **ETS 300 446**: EMC standard for **Cordless Telephone (CT2)** apparatus operating in the frequency band 864,1 - 868,1 MHz, including public access services;
- Part 11: **ETS 300 447**: EMC standard for **VHF FM broadcasting transmitters**;
- Part 12: **EN 300 673**: EMC standard for Very Small Aperture Terminal (**VSAT**), Satellite News Gathering (**SNG**), Satellite Interactive Terminals (**SIT**) and Satellite User Terminals (**SUT**) Earth Stations operated in the frequency ranges between 4 GHz and 30 GHz in the fixed Satellite Service (**FSS**);
- Part 13: **ETS 300 680-1**: EMC standard for **Citizen's Band (CB) Radio** and ancillary equipment (speech and/or non-speech); Part 1: angle-modulated , and **ETS 300 680-2**: EMC standard for **Citizen's Band (CB) Radio** and ancillary equipment (speech and/or non-speech); Part 2: Double Side Band (DSB) and/or Single Side Band (SSB);
- Part 15: **ETS 300 684**: EMC standard for commercially available **amateur radio** equipment;
- Part 16: **ETS 300 717**: EMC standard for **analogue cellular radio** communications equipment; mobile and portable equipment;
- Part 17: **ETS 300 826**: EMC standard for 2,4 GHz Wideband Data Transmission Systems (**WDS**) and **HIPERLAN** equipment in the 5,2 and 17,2 GHz bands;
- Part 18: **EN 300 827**: EMC standard for **TErrestrial Trunked RAdio (TETRA)** and ancillary equipment;
- Part 19: **EN 300 830**: EMC for **Receive Only Mobile Earth Stations (ROMES)** operating in the 1,5 GHz band providing data communications;
- Part 20: **EN 300 831**: EMC for **Mobile Earth Stations (MES)** used within Satellite Personal Communications Networks (**S-PCN**) operating in the 1,5/1,6/2,4 GHz and 2 GHz frequency bands;
- Part 21: **EN 300 832**: EMC for **Mobile Earth Stations (MES)** providing Low Bit Rate Data communications (**LBRDC**) using satellites in Low Earth Orbit (**LEO**) operating in frequency band below 1 GHz;
- Part 22: **EN XXX Vx.x.x (1999-09)**: EMC Standard for ground based VHF hand held, mobile and fixed radio transmitters, receivers and transceivers for the VHF aeronautical mobile service.

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):	36 months after doa

Introduction

The current EMC product standards for radio equipment are all structured as follows:

Clauses 1 to 6 contain information specific to the type of radio equipment covered by the particular standard:

- clause 1, Scope;
- clause 2, Normative references;
- clause 3, Definitions and abbreviations;
- clause 4, Test conditions and configurations;
- clause 5, Performance assessment; and
- clause 6, Performance criteria.

Clause 7 contains the applicability overview tables for emission and immunity.

Clause 8 contains the emission requirements and clause 9 contains the immunity requirements. The requirements set out in these clauses are however identical for all types of radio equipment.

A new structure for these standards has been prepared.

This structure is made up in following way:

- one EMC standard for all radio equipment;
- all the common technical requirements for emission and immunity have been placed in one document which is Part 1 of the present document;
- separate parts have been developed to cover product related specific radio equipment test conditions, test arrangements, performance criteria, normal test modulation, etc.;

NOTE: At this time four drafts for specific radio parts of this EMC standard have been prepared.

- one new clause has been added to each of the specific radio parts entitled "Special conditions", if appropriate. This subclause contains any deviation from the common requirements set out in part one of this EMC standard.

1 Scope

The present document corresponds to 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 part of the present document.

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 the present document for each type of radio equipment, the product related part takes precedence.

Technical specifications related to the antenna port of radio equipment and 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 50081-1 [1] and EN 50082-1 [2] for the residential, commercial and light industrial environment; or
- TR 101 651 [15] for the telecommunication centre environment; or
- ISO 7637-1 [13] and 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 present document may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomena 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.

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] EN 50081-1 (1992): "Electromagnetic compatibility - Generic emission standard - Part 1: Residential, commercial and light industry".
- [2] EN 50082 1 (1997): "Electromagnetic compatibility - Generic immunity standard - Part 1: Residential, commercial and light industry".
- [3] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".
- [4] 1999/5/EC: "Council Directive on the approximation of the laws of the Member States relating to radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity".
- [5] EN 55022: "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".
- [6] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".
- [7] EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. Basic EMC Publication".
- [8] EN 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test".
- [9] EN 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test. Basic EMC Publication".
- [10] EN 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test".
- [11] EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio-frequency fields".
- [12] EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests".
- [13] ISO 7637-1 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".
- [14] ISO 7637-2 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".
- [15] TR 101 651 (1999): Electromagnetic compatibility and Radio spectrum Matters (ERM); Classification of the electromagnetic environment conditions for equipment in telecommunication networks.

- [16] EN 61000-3-2 (1995): "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)".
- [17] EN 61000-3-3 (1995): "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limits of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A per phase".
- [18] IEC 60050-161: "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility".
- [19] CEPT Recommendation 74-01: "Spurious emissions".

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, 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 (IEC 60050-161 [18]).

enclosure port: physical boundary of the apparatus through which electromagnetic fields may radiate or impinge. In the case of integral antenna equipment, this port is inseparable from the antenna port.

integral antenna: antenna designed to be connected directly to the equipment with or without the use of an external connector and considered to be part of the equipment. An integral antenna may be fitted internally or externally to the equipment.

mobile equipment: receiver, transmitter or transmitter/receiver (transceiver) that is 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. 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 1).

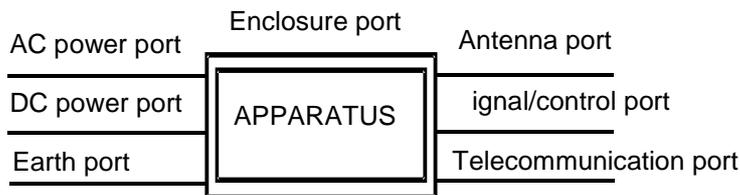


Figure 1: Examples of ports

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

spurious emission: emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions (CEPT Recommendation 74-01 [19]).

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 (see EN 55022 [5]).

transient phenomena: 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 (IEC 60050-161 [18]).

3.2 Abbreviations

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

AC	Alternating Current
DC	Direct Current
EM	ElectroMagnetic
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
IF	Intermediate Frequency
LISN	Line Impedance Stabilizing Networks
RF	Radio Frequency
rms	root mean square

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, the test modulation, test conditions and tests arrangements, etc., are found in the part dealing with the appropriate 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 the present document dealing with each type of radio equipment.

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 the present document for each type of radio equipment.

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 without an antenna connector (i.e. in case of integral antenna equipment), 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 an antenna connector (i.e. in case of non integral antenna equipment), the wanted RF output signal to establish a communication link shall be delivered from that 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.

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 the present document for each type of radio equipment.

For receivers without an antenna connector (i.e. in case of integral antenna equipment), 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 an antenna connector, 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 coaxial cable 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 the present document relevant for each 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 broad band 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 frequency output signal 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. 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)

Transmitter 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 simultaneously 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 the present document.

4.3 Exclusion band of radio communications equipment

For the purpose of EMC tests set up in the present document, the radio communications equipment is subject to an exclusion band. This exclusion band is always product dependent and defined in the relevant part of the present document dealing with each type of radio equipment.

4.4 Narrow band responses of receivers

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 (subclauses 9.2 and 9.5) causes non compliance of the receiver with the specified performance criteria (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 the present document dealing with each 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 the present document dealing with each 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 the present document dealing with each type of radio equipment.

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;
- the environment(s) in which the equipment is intended to be used. This declaration shall be as indicated in the user instructions.

If additional product related information is required, these can be found in the relevant part dealing with each type of radio equipment.

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 of a specialized nature 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 another appropriate Harmonized EMC standard;
- separately from the receiver, the transmitter or transceiver against all applicable immunity and emission clauses of the present document;
- with it connected to a receiver, transmitter or transceiver, in which case compliance shall be demonstrated to the appropriate clauses of the present document.

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:

- base station equipment; or
- mobile equipment; or
- portable equipment.

taking into account the definitions in subclause 3.1 of the present document.

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

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

Subsequently, for multiple use radio and/or ancillary equipment more than one set of equipment test requirements listed in the tables 1 and 2 of clause 7 of the present document has to be taken into consideration.

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, part 1 of 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 the present document dealing with each type of the radio equipment.

6.1 Performance criteria for continuous phenomena applied to transmitters and receivers

If not further detailed in the relevant part of the present document dealing with each radio equipment, the following general performance criteria for continuous phenomena shall apply.

During 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.

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 not further detailed in the relevant part of the present document dealing with each 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 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.

7 Applicability overview tables

The applicability overview tables below gives 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 do not apply.

In these cases, clause 7 of the part of the present document dealing with each type of radio equipment provides specifications or restrictions to the applicability of the EMC tests for the actual type of EUT.

7.1 EMC emission

Table 1: EMC emission measurements for radio and associated ancillary equipment specified in the present document, overview

Phenomenon	Application	Equipment test requirement			Reference subclause in the present document
		Radio and ancillary equipment for fixed or stationary use	Radio and ancillary equipment for vehicular use	Radio and ancillary equipment for portable use	
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
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

7.2 Immunity

Table 2: Immunity tests for radio and associated ancillary equipment specified in the present document, overview

Phenomena	Application	Equipment test requirement			Reference subclause in the present document
		Radio and ancillary equipment for fixed use	Radio and ancillary equipment for vehicular use	Radio and ancillary equipment for portable use	
RF electromagnetic field (80 MHz to 1 000 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 (current clamp injection) 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

8 Methods of measurement and limits for EMC emissions

8.1 Test configuration

This subclause 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;
- an attempt shall be made to maximize the detected radiated emission, e.g. by moving the cables of the equipment;
- where radio equipment is provided with a detachable integral antenna, it shall be tested with the antenna fitted in a manner typical of normal intended use, unless specified otherwise;

- 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 (see clause 1).

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 [5].

8.2.3 Limits

The ancillary equipment shall meet the limits according to EN 55022 [5] (10 m measuring distance) shown in table 3.

Table 3: Limits for radiated emissions from ancillary equipment, measured on a stand alone basis

Frequency range	Limit (Quasi-peak)
30 MHz - 230 MHz	30 dB μ V/m
> 230 MHz - 1 000 MHz	37 dB μ V/m

Alternatively, for ancillary equipment intended to be used in telecommunication centres only, the limits given in table 4 (10 m measuring distance) can be used:

Table 4: 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 μ V/m
> 230 MHz to 1 000 MHz	47 dB μ V/m

8.3 DC power input/output ports

This test is applicable for base station and ancillary equipment for fixed use that may have DC cables longer than 3 m.

If the DC power cable of the radio and/or the ancillary equipment is less than 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 subclause 8.4. If the DC power cable may be 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 [5] and the Line Impedance Stabilizing Networks (LISNs) 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 subclause 4.3) for measurements in the transmit mode of operation.

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission shall be recorded. The LISN measurement ports not being used for the actual measurement shall be terminated with a 50 Ω load.

The equipment shall be installed with a ground plane as defined in EN 55022 [5]. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

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

The measurement receiver shall be in accordance with the requirements of section 1 of CISPR 16-1 [6].

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 subclause 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 [5], shown in table 5.

Table 5: Limits for conducted emissions

Frequency range	Limit (Quasi-peak)	Limit (Average)
0,15 MHz to 0,5 MHz	66 dB μ V - 56 dB μ V	56 dB μ V - 46 dB μ V
> 0,5 MHz to 5 MHz	56 dB μ V	46 dB μ V
> 5 MHz to 30 MHz	60 dB μ V	50 dB μ 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 6 may be used:

Table 6: Limits for conducted emissions of equipment intended to be used in telecommunication centres only

Frequency range	Limit (Quasi-peak)	Limit (Average)
0,02 MHz to 0,15 MHz	79 dB μ V	not defined
> 0,15 MHz to 0,5 MHz	79 dB μ V	66 dB μ V
> 0,5 MHz to 30 MHz	73 dB μ V	60 dB μ V

8.4 AC mains power input/output ports

This test is applicable for base station 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 [5] and the Line Impedance Stabilizing Networks (LISNs) 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 subclause 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 a LISN 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.

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission shall be recorded. The LISN measurement ports not being used for the actual measurement shall be terminated with a 50 Ω load. The measurement receiver shall be in accordance with the requirements of section 1 of CISPR 16-1 [6].

The equipment shall be installed with a ground plane as defined in EN 55022 [5]. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

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 subclause 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 [5], shown in table 7.

Table 7: Limits for conducted emissions

Frequency range	Limit (Quasi-peak)	Limit (Average)
0,15 MHz to 0,5 MHz	66 dB μ V - 56 dB μ V	56 dB μ V - 46 dB μ V
> 0,5 MHz to 5 MHz	56 dB μ V	46 dB μ V
> 5 MHz to 30 MHz	60 dB μ V	50 dB μ 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 8 may be used:

Table 8: 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 μ V	66 dB μ V
> 0,5 MHz to 30 MHz	73 dB μ V	60 dB μ V

8.5 Harmonic current emissions (AC mains input port)

The appropriate requirements of EN 61000-3-2 [16] for harmonic current emission apply for equipment covered by the scope of the present document.

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.

9 Test methods and levels for immunity tests

9.1 Test configuration

This subclause 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 present document dealing with each type 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 a detachable integral antenna, it shall be tested with the antenna fitted in a manner typical of intended use, unless specified otherwise;
- 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)

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 [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 1 000 MHz with the exception of the exclusion band for transmitters or with the exception of the exclusion band for receivers (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 the present document dealing with the relevant type of radio equipment;
- further product related spot frequency tests may be specified in the relevant part of the present document dealing each 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 the present document dealing with each type of radio equipment).

For receivers the performance criteria for continuous phenomena for receivers shall apply (see clause 6 of the relevant part of the present document dealing with each type of radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 [7].

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 [7].

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 (EN 61000-4-2 [7]).

9.3.3 Performance criteria

For transmitters the performance criteria for transient phenomena for transmitter shall apply (see clause 6 of the relevant part dealing with each radio equipment).

For receivers the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part dealing with each radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 [9].

The following requirements and evaluation of test results shall apply:

- the test level for signal and control ports shall be 0,5 kV open circuit voltage as given in EN 61000-4-4 [9];
- the test level for DC power input ports shall be 0,5 kV open circuit voltage as given EN 61000-4-4 [9];
- the test level for AC mains power input ports shall be 1 kV open circuit voltage as given EN 61000-4-4 [9].

For AC and DC power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode). The source impedance shall be 50 Ω .

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 the present document dealing with each 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 the present document dealing with each type of the radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 [11].

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 [11] 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 only the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz, unless specified otherwise in the part dealing with each type of radio equipment;

- for transmitters in transceivers with a non-continuous duty cycle the stepped frequency increments may be 500 kHz in the frequency range 150 kHz to 5 MHz and 10 % frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;
- no intrusive or direct connection shall be made to any of the lines of any input/output port, therefore the current clamp injection method shall be used;
- 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 dealing with each radio equipment).

For receivers the performance criteria for continuous phenomena for receivers shall apply (see clause 6 of the relevant part dealing with each radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 mobile radio and ancillary equipment intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V DC power 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 7637-1 [13] for 12 V DC powered equipment and ISO 7637-2 [14] for 24 V DC powered equipment.

9.6.2.1 Test requirements for 12 V DC powered equipment

Where the manufacturer in his installation documentation requires the radio equipment to have a direct connection to the 12 V main vehicle battery the requirements in a) shall apply.

Where the manufacturer does not require the radio equipment to have a direct connection to the 12 V main vehicle battery the requirements in a) and b) shall apply:

- a) Pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;

Pulse 4, level II, 5 pulses, with the characteristics as follows:

$$V_s = -5 \text{ V}; \quad V_a = -2,5 \text{ V}; \quad t_6 = 25 \text{ ms}; \quad t_8 = 5 \text{ s}; \quad t_f = 5 \text{ ms};$$

- b) Pulse 1, level II: $t_1 = 2,5$ s; 10 pulses;
 Pulse 2, level II: $t_1 = 2,5$ s; 10 pulses;
 Pulse 7, level II: 5 pulses.

Where the manufacturer declares that the radio equipment requires a direct connection to the main vehicle battery, and therefore the tests in accordance with the requirements b) are not carried out, this shall be stated in the test report.

9.6.2.2 Test requirements for 24 V DC powered equipment

Where the manufacturer in his installation documentation requires the radio equipment to have a direct connection to the 24 V main vehicle battery the requirements in c) shall apply.

Where the manufacturer does not require the radio equipment to have a direct connection to the 24 V main vehicle battery the requirements in c) and d) shall apply:

- c) Pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;

Pulse 4, level II, 5 pulses, with the characteristics as follows:

$$V_s = -10 \text{ V}; \quad V_a = -5 \text{ V}; \quad t_6 = 25 \text{ ms}; \quad t_8 = 5 \text{ s}; \quad t_f = 5 \text{ ms};$$

- d) Pulse 1a, level II: $t_1 = 2,5$ s; $R_i = 25 \Omega$; 10 pulses;

Pulse 1b, level II: $t_1 = 2,5$ s; $R_i = 100 \Omega$; 10 pulses.

Where the manufacturer declares that the radio equipment requires a direct connection to the main vehicle battery, and therefore the tests in accordance with the requirements d) are not carried out, this shall be stated in the test report.

Radio and ancillary equipment designed to operate at both DC power voltages shall be tested in both configurations.

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 the present document dealing with each type of radio equipment).

For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria for transient phenomena for transmitter shall apply (see clause 6 of the relevant part of the present document dealing with each 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 the present document dealing with each radio equipment).

For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of the present document dealing with each 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 5) 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 [12].

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 continuous phenomena for transmitter shall apply (see clause 6 of the relevant part of the present document dealing with each type of radio equipment);
- for receivers the performance criteria for continuous phenomena for receiver shall apply (see clause 6 of the relevant part of the present document dealing with each type of radio equipment);
- for ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 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 the present document dealing with each type of radio equipment);
- for receivers the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of the present document dealing with each type of radio equipment);
- for ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 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 the present document dealing with each 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, the product description and the user documentation.

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 subclause 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 [10].

The following requirements and evaluation of test results shall apply:

- the test level for telecommunication ports, intended to be directly connected to a telecommunication network, shall be 0,5 kV line to ground as given in EN 61000-4-5 [10]. In this case the total output impedance of the surge generator shall be 42 Ω ;
- the test level for AC mains power input ports shall be 1 kV line to ground and 0,5 kV line to line with the output impedance of the surge generator as given in the EN 61000-4-5 [10];
- the test generator shall provide the 1,2/50 μ sec pulse as defined in EN 61000-4-5 [10].

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 the present document dealing with each radio equipment).

For receivers the performance criteria for transient phenomena for receivers shall apply (see clause 6 of the relevant part of the present document dealing with each radio equipment).

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see clause 5) 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 and/or subclauses of the present document relevant for compliance with the essential requirements of EC Council Directives

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

Clause/subclause number and title		Corresponding article of Council Directive 89/336/EEC [3]	Corresponding article of Council Directive 1999/5/EC [4]
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)
8.3	DC power input/output ports	4 (a)	3.1 (b)
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)
9	Test methods and levels for immunity tests		
9.2	Radio frequency electromagnetic field (80 MHz - 1 000 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)
9.7	Voltage dips and interruptions	4 (b)	3.1 (b)
9.8	Surges, common and differential mode	4 (b)	3.1 (b)

History

Document history			
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