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**Radio Equipment and Systems (RES);  
ElectroMagnetic Compatibility (EMC) standard for  
Short Range Devices (SRD)  
operating on frequencies between 9 kHz and 25 GHz**

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## Foreword

This draft European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

Other standards cover radio communications equipment not listed in the scope.

This ETS is based upon EN 50081-1 [4] and EN 50082-1 [5] and other standards where appropriate, to meet the essential requirements of the Council Directive 89/336/EEC.

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

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## 1 Scope

This European Telecommunication Standard (ETS) covers the assessment of the Short Range Devices (SRD) product family and ancillary equipment in respect of ElectroMagnetic Compatibility (EMC). Technical specifications related to the antenna port and emissions from the enclosure port of the radio equipment are not included in this ETS. Such technical specifications are found in related radio product standards.

This product family EMC Standard may be superseded by specific product EMC standards, covering a specific application.

This ETS specifies the applicable EMC tests, the method of measurements, the limits and the minimum performance criteria for Short Range Devices, as specified in I-ETS 300 220 [1], I-ETS 300 330 [2] and I-ETS 300 440 [3] depending on the used frequency band, and the associated ancillary equipment.

The environmental classification used in this ETS refers to the environment classification used in the Generic Standards EN 50 081 - 1 [4], EN 50 082 - 1 [5], except the vehicular environment class which refers to the ISO 7637 standard [6].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial, light industrial and vehicular environment. The levels however, do not cover extreme cases which may occur in any location but with low probability of occurrence.

This ETS 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 this ETS, does not signify compliance to any requirements related to spectrum management or any requirement related to the use of the equipment (licensing requirements).

Compliance to this ETS does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment that any observation regarding the equipment becoming dangerous or unsafe as a result of the application of the tests of this ETS should be recorded in the test report.

## 2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] I-ETS 300 220 : "Radio Equipment and Systems (RES); Short range devices Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW".
- [2] I-ETS 300 330 : "Radio Equipment and Systems (RES); Short Range Devices (SRDs) Technical characteristics and test methods for radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz".
- [3] I-ETS 300 440 : "Radio Equipment and Systems (RES); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 1 GHz to 25 GHz frequency range".
- [4] EN 50081-1 (1992): "Electromagnetic compatibility - generic emission standard. Part 1: Residential, commercial and light industry".

- [5] EN 50082-1 (1992) : "Electromagnetic compatibility - generic immunity standard. Part 1: Residential, commercial and light industry".
- [6] ISO 7637-1 (1990) : "Road vehicles - Electrical disturbance by conducting and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".
- [7] ISO 7637-2 (1990) : "Road vehicles - Electrical disturbance by conducting and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".
- [8] EN 55022 (1994) : "Limits and methods of measurement of radio interference characteristics of information technology equipment".
- [9] CISPR 16-1 (1993) : "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".
- [10] ENV 50140 (1993) : "Electromagnetic Compatibility - Basic immunity standard - Radiated, radio-frequency electromagnetic field. Immunity test".
- [11] IEC 1 000-4-2 (1995): "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 2: Electrostatic discharge immunity test. Basic EMC publication".
- [12] IEC 1 000-4-4 (1995): "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 4: Electrical fast transient/burst immunity test. Basic EMC publication".
- [13] ENV 50141 (1993) : "Electromagnetic Compatibility - Basic immunity standard - Conducted disturbances induced by radio-frequency fields. Immunity test".
- [14] IEC 1 000-4-11 (1994) : "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests - Basic EMC publication".
- [15] ENV 50142 (1994) : "Electromagnetic Compatibility - Basic immunity standard. Surge immunity test".
- [16] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility"

### 3 Definitions

For the purpose of this ETS the following definitions apply:

**short range device:** A piece of apparatus which includes a transmitter, and/or a receiver and or parts thereof, used in alarm-, telecommand- and telemetry applications etc., operating with analogue speech/music or data (analogue and/or digital) or with combined analogue speech/music and data, using any modulation type.

These devices can be used in a fixed, mobile or portable application.

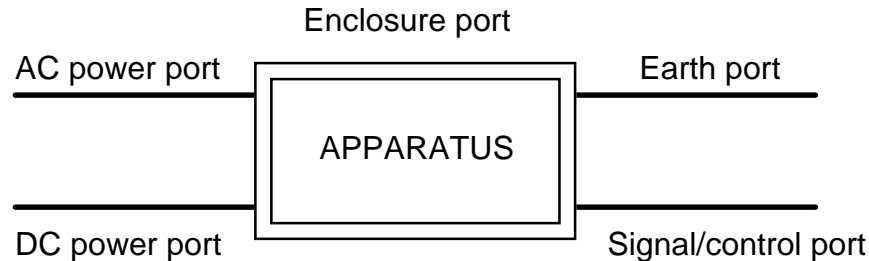
**ancillary equipment:** Equipment (apparatus), used in connection with a receiver, transmitter or transceiver, is considered as an ancillary equipment (apparatus):

- if the equipment is intended for use in conjunction with a receiver, transmitter or transceiver to provide additional operational and/or control features to the radio equipment (e.g. to extend control to another position or location); and
- if the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver, transmitter or transceiver; and



- if the receiver, transmitter, transceiver 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).

**port:** A particular interface of the specified equipment (apparatus) with the electromagnetic environment. (see figure 1).



**Figure 1: Examples of ports**

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

**manufacturer:** The legal entity responsible under the terms of Council Directive 89/336/EEC [16] for placing the product on the market.

## 4 Test conditions

### 4.1 General

The equipment shall be tested under normal test conditions contained in the relevant product and basic standards or in 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 shall be as close to normal intended use as possible and shall be recorded in the test report.

Whenever the EUT is provided with a detachable antenna, the EUT shall be tested with the antenna fitted in a manner typical of normal intended use, unless specified otherwise.

For the purpose of this standard the short range radio devices are divided into three types of equipment, based on the technical nature of the primary function.

**Table 1**

Equipment Type	Technical nature of the primary function
I	Transfer of messages (digital or analogue signals)
II	Transfer of audio (speech or music)
III	Others

### 4.2 Normal test modulation

For equipment type I the carrier shall be modulated with a test signal, representing a practical selection of the usable selective messages/commands. The agreed test signal may be formatted and may contain error detection and correction. Where transmitters do not have a modulation input port, the internal equipment modulation is used.

For equipment type II (audio equipment):

- the wanted input signal of the receiver under test shall be set to the nominal frequency of the receiver, modulated with a sinusoidal audio frequency of 1 000 Hz having a modulation corresponding to 60 % of the peak system modulation;

- the transmitter under test shall be modulated with a sinusoidal audio frequency of 1 000 Hz having a modulation corresponding to 60 % of the system peak modulation.

For equipment type III the manufacturer shall specify the normal test modulation, if any.

#### **4.3 Arrangements for test signals at the input of the transmitter**

The transmitter shall be operated at its maximum rated output, modulated with normal test modulation as specified for that type of equipment (subclause 4.2).

If internal equipment modulation is not available, the signal generator to be used for the modulation signal shall be located outside the test environment and connected to the modulation input of the transmitter via appropriate means. Adequate measures shall be taken to protect the measuring equipment from the effect of all the radiated fields within the test environment.

#### **4.4 Arrangements for test signals at the output of the transmitter**

The measuring equipment used to monitor the output signal of the transmitter shall be located outside the test environment. Adequate measures shall be taken to protect the measuring equipment from the effect of all the radiated fields within the test environment.

The manufacturer may provide a suitable companion receiver that can be used to receive messages or to set up a communication link.

Where the transmitter incorporates an external Radio Frequency (RF) antenna connector, the output signal of the transmitter, shall be coupled to the receiving/measuring equipment via 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.

In case of an equipment not provided with an external RF connector, the output signal of the transmitter shall be coupled to another antenna located within the test environment. This antenna shall be coupled to the receiving/measuring equipment outside the test environment.

#### **4.5 Arrangements for test signals at the input of the receiver**

For receivers, the wanted RF input signal, coupled to the receiver, shall be modulated with normal test modulation as specified for that type of equipment (subclause 4.2).

The source of the wanted input signal shall be located outside the test environment and the level shall be chosen to a value significantly above the threshold sensitivity but below the overload characteristics of the receiver.

The manufacturer may provide a suitable companion transmitter that can be used to transmit messages or to set up a communication link.

Where the receiver incorporates an external RF antenna connector, the wanted input signal shall be coupled to the wanted RF signal source via 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 shielded transmission line at the point of entry to the receiver.

In case of an equipment not provided with an external RF connector the wanted input signal, shall be presented to the receiver from another antenna located within the test environment. This antenna shall be coupled to the wanted RF signal source.

#### **4.6 Arrangements for test signals at the output of the receiver**

For equipment type I it shall be possible to assess the performance of the equipment by appropriately monitoring (observing) the receiver reaction.

For equipment type II the measuring equipment used to monitor the output signal of the receiver shall be located outside the test environment. Adequate measures shall be taken to protect the measuring equipment from the effect of all the radiated fields within the test environment.

For equipment type III, see (subclause 5.5).

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

The transmitter and receiver may be tested together, if appropriate (size of equipment etc.). In this case the transmitter and the receiver shall be located inside the test environment and shall be exposed at the same time to the EMC phenomena. Instead of coupling the output signal of the transmitter (subclause 4.4) to the measuring equipment outside the test environment, this signal shall be coupled, inside the test environment, to input of the receiver (subclause 4.5), via an attenuator, if required, to prevent overload of the receiver.

#### **4.8 Exclusion bands**

Exclusion bands are frequency bands where RF immunity tests are not performed while testing the EUT. Exclusion bands are defined in the following subclauses.

##### **4.8.1 Exclusion bands for receivers.**

The exclusion band for receivers (including receivers part of transceivers) intended to be used in a channellized frequency band, is determined as follows:

- for receivers capable of operating on only one single frequency and not having an alignment range, the lower frequency of the exclusion band is the lower frequency of the used frequency channel minus the extension value given in table 2, and the upper frequency of the exclusion band is the upper frequency of the used frequency channel plus the extension value given in table 2. The calculated values shall be based on the operating frequency;
- for receivers capable of operating on only one single frequency and having an alignment range, the lower frequency of the exclusion band is the lower frequency of the alignment range minus the extension value given in table 2, and the upper frequency of the exclusion band is the upper frequency of the alignment range plus the extension value given in table 2. However, if the alignment range is more than 10% of the upper frequency of the alignment range the calculated value shall be based on 10% of the upper value of the alignment range. The calculated values shall be based on the centre frequency of the alignment range;
- for receivers capable of operating on more than one frequency in an operating frequency band the width of which is less than 20% of the centre frequency of the operating band, the lower frequency of the exclusion band is the lower frequency of the operating band minus the extension value given in table 2, and the upper frequency of the exclusion band is the upper frequency of the operating band plus the extension value given in table 2. The calculated values shall be based on the centre frequency of the operating band;
- for receivers capable of operating on a number of frequencies over a frequency band wider than the band specified above, immunity tests shall be made over a selected number of test frequencies. The selected test frequencies shall be located at three evenly spaced points per logarithmic decade of the frequency band. For each test frequency the lower frequency of the exclusion band is the lower frequency of the used test frequency channel minus the extension value given in table 2, and the upper frequency of the exclusion band is the upper frequency of the used test frequency channel plus the extension value given in table 2. The calculated values shall be based on the used test frequency.

For wide band receivers, i.e. receivers operating in a non-channellized frequency band, the lower frequency of the exclusion band is the lower frequency of the intended operating frequency band minus the extension value given in table 2 and the upper frequency of the exclusion band is the upper frequency of the intended operating band plus the extension value given in table 2, or the total exclusion band is twice the intended operating frequency band of the receiver centred around the centre frequency of the intended operating band, whichever is greater.

Table 2

Operating frequency	Extension value
< 5 MHz	20 %
=> 5 MHz and < 80 MHz	10 % or 1 MHz, whichever is greater
=> 80 MHz	5 % or 10 MHz, whichever is greater

#### 4.8.2 Exclusion band for transmitters

For transmitters operating, or intended to operate, in a channellized frequency band, the exclusion band is three times the maximum occupied bandwidth allowed for that service, centred around the operating frequency.

For wide band transmitters, i.e. transmitters in a non-channellized frequency band, the exclusion band is twice the intended operating frequency band centred around the centre frequency of the intended operating frequency band.

In case the receiver and transmitter are tested together as a system (subclause 4.7) the exclusion band defined for receivers or the exclusion band defined for transmitters shall be used, whichever is greater.

#### 4.9 Narrow band responses of receivers

Responses of receivers or receivers of transceivers occurring during the test at discrete frequencies which are narrow band responses (spurious responses) are identified by the following method.

If during the test the unwanted signal causes non compliance of the receiver with the specified performance level (clause 6), it is necessary to establish whether this non compliance is due to a narrow band response or to a wideband phenomenon. Therefore, the unwanted signal frequency is increased by an amount equal to twice the nominal bandwidth of the receiver pre-demodulation filter, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the receiver is then in compliance with the specified performance level (clause 6), the response is considered as a narrow band response.

If the receiver still does not comply with the specified performance level (clause 6), this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrowband response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and a half times the bandwidth previously referred to. If the receiver still does not comply with the specified performance level, the phenomena is considered wideband and therefore an EMC problem and the equipment fails the test.

Narrow band responses shall be disregarded.

## 5 Performance assessment

### 5.1 General

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

- the primary functions of the radio equipment to be evaluated during and after the EMC tests;
- the intended functions of the EUT which shall be in accordance with the documentation accompanying the equipment;
- the ancillary equipment to be combined with the radio equipment for testing;
- 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 EMC stress;

- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as ac or dc power;
- the bandwidth of the IF filter;
- the applicable equipment type according table 1 (subclause 4.1);

The performance assessment is dependent on the equipment type (subclause 4.1).

For all types of equipment the performance assessment is based on :

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

Additionally:

- for equipment type II the degradation in performance during the radio frequency immunity tests is expressed in a minimum SINAD decibel value;
- for equipment type III the manufacturer shall specify the way the degradation in performance should be measured and expressed.

## **5.2 Additional assessments for portable and mobile equipment**

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

Portable or mobile equipment, or combinations of equipment, declared as capable of being powered for intended use by ac mains shall additionally be considered as a base station equipment.

## **5.3 Receiver and transmitter**

For the purpose of this ETS the following definitions shall be used:

- a receiver is a stand alone receiver or a receiver being part of a transceiver.
- a transmitter is a stand alone transmitter or a transmitter being part of a transceiver.

## **5.4 Ancillary equipment**

At the manufacturers discretion an ancillary equipment may be:

- declared compliant to an appropriate harmonized EMC standard;
- tested separately from a receiver or transmitter to all the applicable immunity and emission clauses of this ETS;
- tested with it connected to a receiver or transmitter, in which case compliance shall be demonstrated to the appropriate clauses of this ETS.

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

## 5.5 Equipment of special nature

In the case of ancillary equipment tested on a stand alone basis and/or radio equipment of a specialised nature or equipment type III the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test. Under these circumstances the manufacturer also provide the following information:

- the pass/failure criteria for the equipment;
- the method of observing a degradation of performance of the equipment.

The degradation of performance assessment which shall be carried out during and/or at the conclusion of the tests, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

## 6 Performance criteria

### 6.1 Classification of equipment

The product family of short range radio devices is divided in to three classes of equipment, each having its own set of minimum performance criteria. This classification is based upon the impact on persons and/or goods in case the equipment does not operate above the specified minimum performance level under EMC stress.

**Table 3**

<b>Class of Equipment</b>	<b>Result of too low performance</b>
1	Physical risk to persons or goods
2	Inconvenience to persons, which cannot simply be overcome by other means
3	Inconvenience to persons, which can simply be overcome by other means ( e.g.manual)

A non-exhaustive list of equipment and its classification is given in annex A.

### 6.2 General performance criteria

The performance criteria for the different classes (see table 3) in combination with the different equipment types (see table 1) during and after immunity test are specified in this subclause:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria for immunity tests with power interruptions exceeding a certain time are specified in (subclause 9.7.3).

The equipment shall meet the minimum performance criteria as specified in the following subclauses, for the appropriate class of equipment.

## 6.3 Performance table

Table 4

<b>Class 1 equipment</b>		
<b>Criteria</b>	<b>During test</b>	<b>After test</b>
A	Operate as intended No loss of function Minimum performance for Equipment type II : 12 dB SINAD No unintentional responses	Operate as intended, for equipment type II : the communication link shall be maintained No loss of function No degradation of performance No loss of stored data or user programmable functions
B	Loss of function (one or more) No unintentional responses	Operate as intended Lost function(s) self-recoverable No degradation of performance No loss of stored data or user programmable functions
<b>Class 2 equipment</b>		
<b>Criteria</b>	<b>During test</b>	<b>After test</b>
A	Operate as intended No loss of function Minimum performance for Equipment type II : 6 dB SINAD No unintentional responses	Operate as intended, for equipment type II : the communication link shall be maintained No loss of function No degradation of performance No loss of stored data or user programmable functions
B	Loss of function (one or more) No unintentional responses	Operate as intended Lost function(s) self-recoverable No degradation of performance No loss of stored data or user programmable functions
<b>Class 3 equipment</b>		
<b>Criteria</b>	<b>During test</b>	<b>After test</b>
A,B	Loss of function (one or more) No unintentional responses	Operate as intended, for equipment type II : the communication link may be lost, recoverable by user No degradation of performance Lost functions self-recoverable

6.4 Performance criteria for Continuous phenomena applied to Transmitters (CT)

If the equipment is of type I or II including ancillary equipment tested on a stand alone basis, the performance criteria A of the applicable class as given in (subclause 6.3) shall apply.

For equipment of type II or type III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence.

Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that unintentional transmission does not occur.

6.5 Performance criteria for Transient phenomena applied to Transmitters (TT)

If the equipment is of the type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria B of the applicable class as given in (subclause 6.3) shall apply, except for power interruptions exceeding a certain time the performance criteria deviations are specified in (subclause 9.7.3.).

For equipment of the type II or type III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence.

Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that unintentional transmission does not occur.

## 6.6 Performance criteria for Continuous phenomena applied to Receivers (CR)

If the equipment is of the type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria A of the applicable class as given in (subclause 6.3) shall apply.

For equipment of the type II or III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence.

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

## 6.7 Performance criteria for Transient phenomena applied to Receivers (TR)

If the equipment is of the type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria B of the applicable class as given in (subclause 6.3) shall apply, except for power interruptions exceeding a certain time the performance criteria deviations are specified in (subclause 9.7.3).

For equipment of the type II or type III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence.

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

## 7 Applicability overview table

### 7.1 Emission

Table 5

Application	Equipment test requirement			Reference subclause in this ETS	Reference document
	Base station & ancillary equipment for fixed use	Mobile & ancillary equipment for vehicular use	Portable & ancillary equipment for portable use		
Enclosure	applicable to ancillary equipment	applicable to ancillary equipment	applicable to ancillary equipment	8.2	EN 55022 [8]
dc power in/out	applicable	applicable	not applicable	8.3	EN 55022 [8] CISPR 16-1 [9]
ac mains	applicable	not applicable	not applicable	8.4	EN 55022 [8]



## 7.2 Immunity

Table 6

Phenomena	Application	Equipment test requirement			Reference subclause in this ETS	Reference document
		Base station & ancillary equipment for fixed use	Mobile & ancillary equipment for vehicular use	Portable & ancillary equipment for portable use		
RF electro magnetic field (80 –1 000 MHz)	Enclosure	applicable	applicable	applicable	9.2	ENV 50140 [10]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.3	IEC 1 000-4-2 [11]
Fast transients common mode	Signal and control ports, dc and ac power ports	applicable	not applicable	not applicable	9.4	IEC 1 000-4-4 [12]
RF common mode (current clamp injection) 0,15-80 MHz	Signal and control ports, dc and ac power ports	applicable	applicable	not applicable	9.5	ENV 50141 [13]
Transients and surges	DC power input ports	not applicable	applicable	not applicable	9.6	ISO 7637 Parts 1 [6] and 2 [7]
Voltage dips and interruptions	AC mains power input ports	applicable	not applicable	not applicable	9.7	IEC 1 000-4-11 [14]
Surges, common and differential mode	AC mains power input ports	applicable	not applicable	not applicable	9.8	ENV 50142 [15]

## 8 Test methods for emission tests for transmitters and/or receivers and/or ancillaries

### 8.1 Test configuration

This subclause defines the requirements for test configurations for tests in the following subclauses and are as follows:

- 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 of a nominal/typical operation, where practical;
- an attempt shall be made to maximise the detected radiated emission, e.g. by moving the cables of 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 while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- 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 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 test shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment.

## 8.2 Enclosure

This test is applicable to ancillary equipment not incorporated in the radio equipment. This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

### 8.2.1 Definition

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

### 8.2.2 Test method

The test method shall be in accordance with EN 55022 [8].

### 8.2.3 Limits

The EUT shall meet the limits according to EN 55022 class B (10m measuring distance), as shown in table 7.

**Table 7**

Frequency range	Quasi-peak
30 - 230 MHz	30 dB $\mu$ V/m
> 230 MHz - 1 000 MHz	37 dB $\mu$ V/m

## 8.3 DC power input/output ports

This test is applicable for base station, mobile and ancillary equipment which may have DC cables longer than 3 metres.

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

### 8.3.1 Definition

This test assesses the ability of transmitters, receivers and ancillary equipment to limit its internal noise present on the dc power input/output ports.

### 8.3.2 Test method

For equipment with a current consumption below 16 A the test method shall be in accordance with EN 55022 [8] and the Line Impedance Stabilizing Networks (LISNs) shall be connected to a dc power source.

For equipment with a current consumption above 16 A the dc power ports shall be connected to 5 $\mu$ H (LISNs), with 50  $\Omega$  characteristic impedance measuring ports. The LISNs shall be in accordance with the requirements of section two of CISPR 16-1 [9].

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

The equipment shall be installed with a ground plane as defined in EN 55022 [8] (subclause 9.3). The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of section one of CISPR 16-1 [9]

### 8.3.3 Limits

The EUT shall meet the limits according to EN 55022 class B, as shown in table 8, 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) above. 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 receiver is unnecessary.

**Table 8**

Frequency range	Quasi-peak	Average
0,15 - 0,5 MHz	66 - 56 dB $\mu$ V	56 - 46 dB $\mu$ V
> 0,5 - 5 MHz	56 dB $\mu$ V	46 dB $\mu$ V
> 5 - 30 MHz	60 dB $\mu$ V	50 dB $\mu$ V
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,5 MHz		

## 8.4 AC mains power in/out

This test is applicable for equipment under test, powered by the ac mains

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

### 8.4.1 Definition

This test assesses the ability of transmitters, receivers and ancillary equipment to limit its internal noise present on the ac mains power input ports.

### 8.4.2 Test method

The test method shall be in accordance with EN 55022 [8].

### 8.4.3 Limits

The EUT shall meet the limits according to EN 55022 class B, as shown in table 8.

## 9 Test methods for immunity tests for transmitters and/or receivers and/or ancillaries

### 9.1 Test configuration

- the measurement shall be made in operational mode as required in (subclause 4.1);
- 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;
- 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;

- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- if 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 tests shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment.

## **9.2 Radio frequency electromagnetic field (80 - 1 000 MHz)**

This test is applicable for base station, mobile, portable and ancillary equipment.

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

### **9.2.1 Definition**

This test assesses the ability of transmitters, receivers and ancillary equipment 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 ENV 50140 [10].

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 400 Hz;
- for receivers and transmitters of class 1 or class 2, the stepped frequency increments shall be 1 % of the momentary frequency; for class 3 products, the stepped frequency increments shall be 10 % of the momentary frequency;
- the test shall be performed over the frequency range 80 - 1 000 MHz with the exception of an exclusion band valid for the EUT (subclause 4.8);
- for a transmitter and a receiver tested as a system (subclause 4.7) the exclusion band defined in (subclause 4.8.2) shall be respected;
- responses in receivers occurring at discrete frequencies which are narrowband responses, are disregarded from the test,(subclause 4.9);
- the frequencies selected during the test shall be recorded in the test report.

### **9.2.3 Performance criteria**

For transmitters the performance criteria CT (subclause 6.4) shall apply.

For receivers the performance criteria CR (subclause 6.6) shall apply.

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

### **9.3 Electrostatic discharge**

This test is applicable for base station, mobile, portable and ancillary equipment.

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

#### **9.3.1 Definition**

This test assesses the ability of transmitters, receivers and ancillary equipment to operate as intended in the event of an electrostatic discharge.

#### **9.3.2 Test method**

The test method shall be in accordance with IEC 1 000-4-2 [11]

For transmitters, receivers and ancillary equipment the following requirements and evaluation of test results shall apply:

- for contact discharge the EUT shall pass the test at  $\pm 2$  kV and  $\pm 4$  kV; for air discharge the equipment shall pass the test at  $\pm 2$  kV,  $\pm 4$  kV and  $\pm 8$  kV;
- electrostatic discharges shall be applied to all exposed surfaces of the EUT, except these exposed surfaces where the user documentation specifically indicates a requirement for appropriate protective provisions, and with the exception of the centre pin of shielded RF connectors.

#### **9.3.3 Performance criteria**

For transmitters the performance criteria TT (subclause 6.5) shall apply.

For receivers the performance criteria TR (subclause 6.7) shall apply.

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

### **9.4 Fast transients common mode**

This test is applicable for base station and fixed ancillary equipment.

This test shall be performed on signal ports, control ports and dc power ports if the cables may be longer than 3 m.

This test shall be performed on ac mains input ports.

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

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.

#### **9.4.1 Definition**

This test assesses the ability of transmitters, receivers and ancillary equipment 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 IEC 1 000-4-4 [12].

For transmitters, receivers and ancillary equipment, which have cables longer than 3 m, or is connected to the ac mains, the following requirements and evaluation of test results shall apply:

- the test level for signal and control ports shall be severity level 3 corresponding to 1 kV open circuit voltage;
- the test level for dc power input ports shall be severity level 2 corresponding to 1 kV open circuit voltage;
- the test level for ac mains power input ports shall be severity level 3 corresponding to 2 kV open circuit voltage;
- 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  $\Omega$ .

#### 9.4.3 Performance criteria

For transmitters the performance criteria TT (subclause 6.5) shall apply.

For receivers the general performance criteria TR (subclause 6.7) shall apply.

For ancillary the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary is tested in connection with receivers or transmitters in which case the corresponding performance criteria shall apply.

#### 9.5 Radio frequency common mode (current clamp injection)

This test is applicable for base station, mobile and ancillary equipment.

This test shall be performed on signal, control and dc power ports of mobile and ancillary equipment, which may have cables longer than 2 m.

This test shall be performed on signal, control, dc power ports and ac mains power ports of base station and fixed ancillary equipment which may have cables longer than 1 m.

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

##### 9.5.1 Definition

This test assesses the ability of transmitters, receivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the input/output ports. This test substitutes radiated radio frequency electromagnetic immunity testing in the frequency range 150 kHz to 80 MHz.

##### 9.5.2 Test method

The test method shall be in accordance with ENV 50141 [13].

The following requirements and evaluation of test results shall apply:

- no intrusive or direct connection shall be made to any or the lines of any input/output port, consequently the clamp injection method shall be used;

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 400 Hz;
- for receivers and transmitters, the stepped frequency increments in the frequency range 150 kHz to 5 MHz shall be 50 kHz; frequency in the frequency range 5 MHz - 80 MHz the stepped frequency increment shall be 1% for products of class 1 or class 2 and 10 % for products of class 3;
- the test level shall be severity level 2 as given in ENV 50141 [13] corresponding to 3 V RMS (measured unmodulated);
- the test shall be performed over the frequency range 150 kHz - 80 MHz with the exception of the exclusion band valid for the EUT,(subclause 4.8);
- responses in receivers occurring at discrete frequencies which are narrowband responses, are disregarded from the test, (subclause 4.9);
- the frequencies selected during the test shall be recorded in the test report.

### **9.5.3 Performance criteria**

For transmitters the general performance criteria CT (subclause 6.4) shall apply.

For receivers the general performance criteria CR (subclause 6.6) shall apply.

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

## **9.6 Transients and surges, vehicular environment**

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

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

### **9.6.1 Definition**

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of transients and surges present on the dc power input ports in a vehicular environment.

### **9.6.2 Test methods and levels**

The test method shall be in accordance with ISO 7637 Part 1 [6] for 12 V dc powered equipment and ISO 7637 Part 2 [7] 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 EUT to have a direct connection to the 12 V main vehicle battery the requirements a) shall apply.

Where the manufacturer does not require the EUT to have a direct connection to the 12 V main vehicle battery the requirements a) and b) shall apply.

a) requirements when a direct connection to the main vehicle battery is required:

- pulse 3a and 3b, level II, with the test time reduced to 5 min for each;

- pulse 4, level II, 5 pulses, with the characteristics as follows:
- $V_s - 5\text{ V}$ ,  $V_a - 2.5\text{ V}$ ,  $t_6 - 25\text{ ms}$ ,  $t_8 - 5\text{ s}$ ,  $t_f - 5\text{ ms}$ .

b) additional requirements when a direct connection to the main vehicle battery is not required:

- pulse 1, level II,  $t_1 - 2.5\text{ s}$ , 10 pulses;
- pulse 2, level II,  $t_1 - 2.5\text{ s}$ , 10 pulses;
- pulse 7, level II, 5 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicular 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 EUT to have a direct connection to the 24 V main vehicle battery the requirements c) shall apply;

Where the manufacturer does not require the EUT to have a direct connection to the 24 V main vehicle battery the requirements c) and d) shall apply.

c) requirements when a direct connection to the main vehicle battery is required:

- Pulse 3a and 3b, level II, with the test time reduced to 5 min for each;
- Pulse 4, level II, 5 pulses, with the characteristics as follows:
- $V_s - 10\text{ V}$ ,  $V_a - 5\text{ V}$ ,  $t_6 - 25\text{ ms}$ ,  $t_8 - 5\text{ s}$ ,  $t_f - 5\text{ ms}$ .

d) additional requirements when a direct connection to the main vehicle battery is not required:

- Pulse 1a, level II,  $t_1 - 2.5\text{ s}$ ,  $R_i - 25\ \Omega$  10 pulses;
- Pulse 1b, level II,  $t_1 - 2.5\text{ s}$ ,  $R_i - 100\ \Omega$  10 pulses;
- Pulse 7, level II,  $t_1 - 2.5\text{ s}$ , 10 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicular 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 CT (subclause 6.4) shall apply. For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria TT (subclause 6.5) shall apply, with the exception that a communication link need not to be maintained during exposure and may have to be re-established.

For receivers pulse 3a and 3b the performance criteria CR (subclause 6.6) shall apply. For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria TR (subclause 6.7) shall apply, with the exception that a communication link need not to be maintained during exposure and may have to be re-established.

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



## 9.7 Voltage dips and interruptions

These test are applicable for base station and fixed ancillary equipment, powered by ac mains.

These test shall be performed on ac mains input ports.

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

### 9.7.1 Definition

These test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the ac mains 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 IEC 1 000-4-11 [14].

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 > 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 shall apply:

- for transmitters the performance criteria CT (subclause 6.4);
- for receivers the performance criteria CR (subclause 6.6);
- for ancillary the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with receivers, transmitters or transceivers 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 shall apply:

- for transmitters, belonging to class 1 equipment, the performance criteria CT (subclause 6.4);
- for transmitters, belonging to class 2 or 3 equipment, the performance criteria TT (subclause 6.5);
- for receivers, belonging to class 1 equipment, the performance criteria CR (subclause 6.6);
- for receivers, belonging to class 2 or 3 equipment, the performance criteria TR (subclause 6.7);
- for ancillary the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with receivers, transmitters or transceivers in which case the corresponding performance criteria above shall apply.

For a voltage interruption corresponding to a reduction of the supply voltage of > 95% for 5 000 ms the following performance criteria shall apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria TT (subclause 6.5) or TR (subclause 6.7) shall apply as appropriate;

- 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 shall 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 data, this fact shall be recorded in the test report, the product description and the user documentation.

## **9.8 Surges common and differential mode**

These test are applicable for base station and fixed ancillary equipment.

These test shall be performed on ac mains power input ports.

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

### **9.8.1 Definition**

These test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of surges present on the ac mains power input ports.

### **9.8.2 Test method**

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with ENV 50142 [15]:

- the test level shall be severity level 2 corresponding to 1 kV open circuit voltage for common mode and severity level 2 corresponding to 0,5 kV open circuit voltage for differential mode;
- the surges shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground, (true common mode). Series resistance shall be 10  $\Omega$ .

### **9.8.3 Performance criteria**

For transmitters the performance criteria TT (subclause 6.5) shall apply.

For receivers the performance criteria TR (subclause 6.7) shall apply.

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

## Annex A (normative): Performance classification of short range radio devices

This normative annex classifies the short range devices into the three performance classes as mentioned in(subclause 6.1).

The classification is given in three tables for the applications "Telecommand/Telecontrol equipment" (table A.1), "Telemetry" equipment" and "Wireless sensing/measuring" (table A.2), "Alarm equipment" (table A.3) and "Other applications" (table A.4).

The required performance class shall be selected according the equipment application as mentioned in these tables, or in case a specific application is not mentioned, the application in the tables closest to the application of that specific equipment shall be selected.

**Table A.1**

<b>Class</b>	<b>Application</b>
	<b>Telecommand/Telemetry</b>
3	Garage door openers
3	Car Lock/Unlock devices
1	Remote control, models -planes
2	Remote control, models - ships, cars etc.
3	Remote control toys general
3	Remote control t.v., Audio etc.
2	Remote control appliances & lighting etc. for residential use only
3	RF door bell
3	Baby monitor
1	Remote control power & lighting
1	Remote surveillance switching
1	Remote control cranes etc.
1	Remote control grass cutting tractors etc.
1	Emergency shutdown controls
2	Level indicators

**Table A.2**

<b>Class</b>	<b>Application</b>
	<b>Telemetry</b>
1	Person identification
2	Animal identification
2	Product identification
2	Cargo handling and/or store (warehouse) systems
2	Domestic telemetry
1	Telemetry in vehicles
	<b>Wireless sensing/measuring</b>
1	Machine tools/robotics
1	Fire detection
1	Crane weigher
1	Process control
1	Position locator
1	Mooring loads
1	Wireless data communication

**Table A.3**

<b>Class</b>	<b>Application</b>
	<b>Alarms</b>
1	Domestic security
2	Car alarms
2	Anti-theft
1	Guard systems
1	Personal security
1	Victims of avalanche
1	Elderly persons
1	Mental institutions etc
2	Building management systems
2	Radio call alert
1	Baby/nursery monitor - non domestic
2	Detection
2	Offender monitoring

**Table A.4**

<b>Class</b>	<b>Application</b>
	<b>Other Applications</b>
2	Video cordless terminals
2	Cordless local networks
2	Identification of rail wagons
1	Identification/Access control
2	Domestic transmission of sound & vision
1	Medical telemetry
2	Deaf education systems
2	Surface probing radar
2	Vehicle detection/monitoring

**History**

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