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**Radio Equipment and Systems (RES);  
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commercially available amateur radio equipment**

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## Contents

Foreword .....		7
1	Scope .....	9
2	Normative references .....	9
3	Definitions .....	10
4	Test conditions .....	12
4.1	Test conditions: general .....	12
4.1.1	EUT test frequencies .....	12
4.2	Test conditions: immunity testing .....	13
4.2.1	Arrangements for wanted signals at the modulation input of the transmitter .....	13
4.2.2	Arrangements for monitoring the RF output of the transmitter .....	13
4.2.3	Arrangements for wanted signals at the input of the receiver .....	13
4.2.4	Arrangements for monitoring the output of the receiver .....	13
4.2.5	Receiver: exclusion band for immunity testing .....	14
4.2.6	Receiver: narrow band responses .....	14
4.2.7	Transmitter: exclusion band for immunity testing .....	14
4.3	Test conditions: emissions testing .....	15
4.3.1	Transmitter: exclusion band for emissions testing .....	15
5	Performance assessment .....	15
5.1	General .....	15
5.2	Equipment classification .....	15
6	Performance criteria .....	16
6.1	General performance criteria (primary user functions) .....	17
6.2	Particular performance criteria: (primary user functions) transmitters, receivers, transceivers, RF amplifiers and transverters .....	17
6.2.1	Tests with phenomena of a continuous nature .....	17
6.2.2	Tests with phenomena of a transient nature .....	18
6.2.3	Tests with voltage dips .....	18
6.2.4	Tests with power interruptions .....	18
6.3	Particular performance criteria: ancillary equipment .....	18
6.4	General performance criteria (secondary user functions) .....	18
7	Applicability overview tables .....	19
7.1	Emissions testing .....	19
7.2	Immunity testing .....	20
8	Test methods and limits for emission tests .....	20
8.1	Emission: antenna port .....	20
8.1.1	Definitions .....	20
8.1.2	Method of measurement .....	20
8.1.3	Limits: antenna port in transmitter-active mode .....	21
8.1.4	Limits: antenna port in standby mode .....	22
8.1.5	Limits: antenna port in receive mode .....	22
8.2	Emissions: enclosure port .....	22
8.2.1	Definition .....	22
8.2.2	Method of measurement .....	22
8.2.2.1	Test sites and general arrangements for measurements involving the use of radiated fields .....	22
8.2.2.1.1	Outdoor test site .....	22
8.2.2.1.2	Standard position .....	23

	8.2.2.1.3	Test antenna .....	23
	8.2.2.1.4	Optional additional indoor site .....	24
	8.2.2.2	Guidance on the use of radiation test sites .....	24
	8.2.2.2.1	Measuring distance .....	24
	8.2.2.2.2	Test antenna .....	25
	8.2.2.2.3	Substitution antenna.....	25
	8.2.2.2.4	Auxiliary cables .....	25
	8.2.2.3	Further optional alternative indoor test site using a fully anechoic RF chamber .....	25
	8.2.2.3.1	Example of the construction of a shielded anechoic chamber .....	25
	8.2.2.3.2	Influence of parasitic reflections in anechoic chambers .....	26
	8.2.2.3.3	Calibration of the shielded RF anechoic chamber .....	26
	8.2.2.4:	General description of measurement methods.....	27
	8.2.2.4.1	Radiated measurements .....	27
	8.2.3	Limits: transmitter active mode.....	29
	8.2.4	Limits: standby mode.....	29
	8.2.5	Limits: receive mode.....	29
8.3		Emission: dc power input/output port .....	30
	8.3.1	Definition .....	30
	8.3.2	Method of measurement.....	30
	8.3.3	Limits: transmitter active mode.....	31
	8.3.4	Limits: standby mode.....	31
	8.3.5	Limits: receive mode.....	31
8.4		Emission: ac mains power input/output port .....	32
	8.4.1	Definition.....	32
	8.4.2	Method of measurement:.....	32
	8.4.3	Limits: transmit active mode .....	32
	8.4.4	Limits: standby mode.....	33
	8.4.5	Limits: receive mode.....	33
9		Test methods and levels for immunity tests .....	33
	9.1	Test configuration.....	33
	9.1.1	Arrangement for test signals in receive mode .....	34
	9.2	Immunity: antenna port, RF conducted .....	34
	9.2.1	Definition.....	34
	9.2.2	Method of measurement: transmitter active mode .....	34
	9.2.3	Receive mode.....	34
	9.2.3.1	Method of measurement .....	34
	9.2.3.2	Arrangement for test signals .....	35
	9.3	Immunity: enclosure port.....	35
	9.3.1	Definition.....	35
	9.3.2	Transmitter active mode .....	36
	9.3.2.1	Method of measurements: RF immunity.....	36
	9.3.2.2	Levels: RF immunity.....	36
	9.3.2.3	Method of measurement: electrostatic discharge .....	36
	9.3.2.4	Levels: electrostatic discharge .....	36
	9.3.3	Standby and receive mode .....	36
	9.3.3.1	Method of measurement: RF immunity.....	36
	9.3.3.2	Levels: RF immunity.....	36
	9.3.3.3	Method of measurement: electrostatic discharge .....	36
	9.3.3.4	Levels: electrostatic discharge .....	37
	9.4	Immunity: dc power input / output port .....	37
	9.4.1	Definition.....	37
	9.4.2	Transmitter active mode .....	37
	9.4.2.1	Method of measurement: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection).....	37
	9.4.2.2	Levels: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection).....	37
	9.4.2.3	Method of measurement: fast transients common mode ...	37
	9.4.2.4	Levels: fast transients common mode .....	38

9.4.3	Standby and receive mode.....	38
9.4.3.1	Method of measurement: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection) .....	38
9.4.3.2	Levels: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection) .....	38
9.4.3.3	Method of measurement: fast transients common mode ....	38
9.4.3.4	Levels: fast transients common mode .....	39
9.5	Immunity: ac power input / output port.....	39
9.5.1	Definition .....	39
9.5.2	Transmitter active mode.....	39
9.5.2.1	Method of measurement: RF electromagnetic disturbance common mode, 0,15 - 80 MHz (current clamp injection)....	39
9.5.2.2	Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection) .....	39
9.5.2.3	Method of measurement: fast transients common mode ....	39
9.5.2.4	Levels: fast transients common mode .....	40
9.5.2.5	Method of measurement: surges common and differential mode.....	40
9.5.2.6	Levels: surges common and differential mode.....	40
9.5.2.7	Method of measurement: voltage dips and power interruptions .....	40
9.5.2.8	Levels: voltage dips and power interruptions.....	41
9.5.3	Standby mode .....	41
9.5.3.1	Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection).....	41
9.5.3.2	Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection) .....	41
9.5.3.3	Method of measurement: fast transients common mode ....	41
9.5.3.4	Levels: fast transients common mode .....	41
9.5.3.5	Method of measurement: surges common and differential mode.....	41
9.5.3.6	Levels: surges common and differential mode.....	42
9.5.3.7	Method of measurement: voltage dips and power interruptions .....	42
9.5.3.8	Levels: voltage dips and power interruptions.....	42
9.5.4	Receive mode .....	42
9.5.4.1	Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection).....	42
9.5.4.2	Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection) .....	43
9.5.4.3	Method of measurement: fast transients common mode ....	43
9.5.4.4	Levels: fast transients common mode .....	43
9.5.4.5	Method of measurement: surges common and differential mode.....	43
9.5.4.6	Levels: surges common and differential mode.....	43
9.5.4.7	Method of measurement: voltage dips and power interruptions .....	43
9.5.4.8	Levels: voltage dips and power interruptions.....	44
9.6	Immunity: signal/control input/output port .....	44
9.6.1	Definition .....	44
9.6.2	Transmitter active mode.....	44
9.6.2.1	Method of measurement: RF electromagnetic disturbance common mode, 0,15 - 80 MHz (current clamp injection)....	44
9.6.2.2	Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection) .....	45
9.6.2.3	Method of measurement: fast transients common mode ....	45
9.6.2.4	Levels: fast transients common mode .....	45
9.6.3	Standby mode .....	45
9.6.3.1	Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection).....	45
9.6.3.2	Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection) .....	46
9.6.3.3	Method of measurement: fast transients common mode ....	46

	9.6.3.4	Levels: fast transients common mode .....	46
9.6.4	Receive mode.....		46
	9.6.4.1	Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection) .....	46
	9.6.4.2	Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection).....	47
	9.6.4.3	Method of measurement: fast transients common mode ...	47
	9.6.4.4	Levels: fast transients common mode .....	47
9.7	Immunity: vehicle dc power interface port.....		47
	9.7.1	Definition.....	47
	9.7.2	Method of measurement.....	47
	9.7.3	Immunity levels: 12 V dc powered equipment .....	48
	9.7.4	Immunity levels: 24 V dc powered equipment .....	48
	History .....		50

## 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 ETSs cover radio communications equipment are not listed in the scope.

This ETS 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 the Council Directive 89/336/EEC [3].

This draft ETS is intended to become a Harmonized EMC Standard, the reference and title of which is intended for publication in the Official Journal of the European Communities. It has been developed in anticipation of a standardisation mandate from the European Commission. It will not be submitted for the Vote phase of the ETSI standards approval procedure until such a mandate has been received and adopted by ETSI.

<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 draft European Telecommunications Standard (ETS) covers the assessment of radio communication and ancillary equipment in respect of ElectroMagnetic Compatibility (EMC), and is intended to become a Harmonized EMC Standard, which may be used to demonstrate presumption of compliance with the protection requirements of the Council Directive 89/336/EEC [3] Article 4 (EMC Directive).

This ETS specifies the applicable EMC tests, the methods of measurement, the limits and the minimum performance criteria for radio equipment intended to be used by radio amateurs within the meaning of article 1, definition 53 of the Radio Regulations in the International Telecommunications Convention and which is available commercially.

This ETS applies to amateur radio equipment either manufactured commercially as ready-to-use equipment or as modules or components having an intrinsic functionality.

The environment classification used in this ETS refers to the environment classification used in the generic standards EN 50081-1 [1], EN 50082-1 [2], except the vehicular environment class which refers to ISO 7637 [13], [14].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial, light industrial and vehicular environments. The levels however, do not cover extreme cases which may occur in any location but with a 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 the use of the equipment (i.e. 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 properly documented.

## 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] | EN 50081-1: "Electromagnetic compatibility - generic emission standard. Part 1: Residential, commercial and light industry".                                |
| [2] | EN 50082-1: "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] | ITU Radio Regulations 1 - 18 clause 146   |
| [5] | EN 55022: "Limits and methods of measurement of radio interference 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] ENV 50140: "Electromagnetic Compatibility - Basic immunity standard - Radiated, radio-frequency electromagnetic field. Immunity test".
- [8] IEC 1000-4-2: "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 2: Electrostatic discharge immunity test. Basic EMC publication".
- [9] IEC 1000-4-4: "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 4: Electrical fast transient/burst immunity test. Basic EMC publication".
- [10] ENV 50141: "Electromagnetic Compatibility - Basic immunity standard - Conducted disturbances induced by radio-frequency fields. Immunity test".
- [11] EN 61000-4-11: Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests - Basic EMC publication".
- [12] ENV 50142: "Electromagnetic Compatibility - Basic immunity standard. Surge immunity test".
- [13] ISO 7637: "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".
- [14] ISO 7637: "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".

NOTE: The stated references are undated which means that the latest version of the relevant standard applies.

### 3 Definitions

For the purposes of this ETS, the following definitions apply:

**base station equipment:** Used to describe amateur radio equipment which is powered from the public ac power network, either directly or indirectly to an ac/dc converter.

**integral antenna:** An antenna designed to be connected to the equipment 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.

**manufacturer:** (supplier) the legal entity responsible under the terms of the Council Directive, 89/336/EEC [3], for placing the product on the market in an EU member state.

**maximum usable sensitivity:** Minimum receiver RF input signal level to produce a specified analogue SINAD ratio or Bit Error Rate (BER), or other specified output quality measure, which is input signal level related.

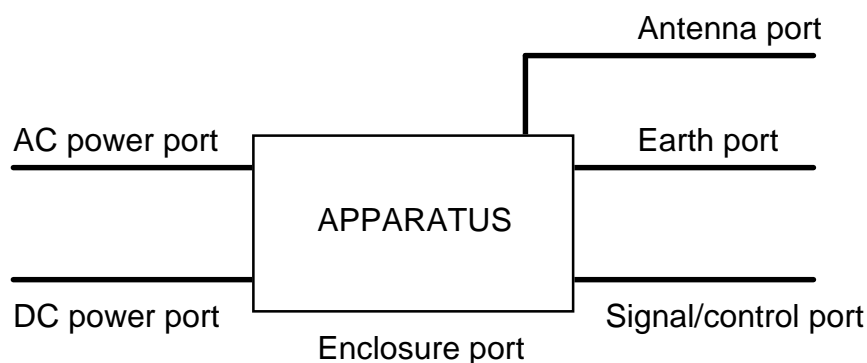
**mobile equipment:** Used to describe all amateur radio equipment powered by a vehicular power supply.

**spurious emissions:** Emissions 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.

**out-of-band emissions:** Emissions on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

**unwanted emission:** Consists of spurious emissions and out-of-band emissions.

**port:** A particular interface of the specified apparatus with the external electromagnetic environment. Any connection point to 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**

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

**portable equipment:** Used to describe all portable amateur radio equipment powered by an internal (and/or) external battery.

NOTE: More than one of the equipment classifications may apply to certain equipment as described in subclause 5.2 depending upon the manufacturer's declaration of normal intended use.

**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
- the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver, transmitter or transceiver; and
- the receiver, transmitter or 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's basic functions).

**support equipment:** This is equipment that can be used with the EUT, but which has functionality when used alone. Modems and/or PC connections are also to be regarded as support equipment, and not as ancillary equipment.

NOTE: The philosophy depends on the manufacturer. It is up to him to declare, for example, his power supply unit as an integral part of his radio equipment or as a stand-alone item which would be declared compliant separately. Typical examples of ancillary equipment include: microphones, loudspeakers, morse keys (manual or automatic/electronic), desktop 'drop-in' battery chargers for hand-held portables. Remote front-panels may be considered as ancillary equipment only if the radio has an integral, permanent front panel as well. Otherwise, demountable front-panels should be considered as an integral part of the EUT. Embedded PCB assemblies sold as options, which increase or change the EUT functionality, are regarded as integral to the EUT and not as ancillary equipment. Snap-on battery packs are also integral parts of the EUT and not ancillary equipment. Plug-in or screw-on whip antennas are regarded as integral parts of the EUT and not ancillary equipment, even if the interface is a 50  $\Omega$  connector.

## 4 Test conditions

### 4.1 Test conditions: general

This subclause defines the requirements for the general test configuration and are as follows:

- the equipment shall be tested under conditions which are within the manufacturers declared range of humidity, temperature and supply voltage;
- the test configuration shall be as close as possible to normal intended use;
- where portable (handheld) 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 in this ETS;
- if equipment with an integral antenna provides an internal antenna connector for testing purposes, the tests can be made via the terminal;
- 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 configuration of ancillary equipment necessary to exercise the ports;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate the actual operating conditions and to ensure that all different types of termination are tested;
- 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 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 tests shall be carried out at a point within the specified normal operating environmental range at the rated supply voltage for the equipment;
- the test conditions, test configurations modes of operation and the test methods used shall be properly documented.

The manufacturer shall recommend a power supply for use with the equipment under test (EUT), to ensure satisfactory operation of the combination during EMC testing. In the event that a range of power supply units can be used with several of that manufacturer's radios, then each power supply unit shall be tested with the radio having the highest RF output Peak Envelope Power (PEP). These power supply units shall then be listed as preferred items for future generations of that manufacturer's radios.

#### 4.1.1 EUT test frequencies

Testing shall be performed with the EUT set to frequencies as follows:

- single-band equipment: test at the centre of the band;
- double-band equipment: test at the centre of both bands;
- HF multi-band equipment or VHF/UHF multi-band equipment: test at the centre of the lowest, the centre of the middle, and the centre of the highest band;
- HF/VHF, HF/UHF or HF/VHF/UHF combined equipment: test at the centre of the lowest HF band, the centre of the middle HF band, the centre of the highest HF band, the centre of the lowest VHF/UHF band, the centre of the middle VHF/UHF band, and the centre of the highest VHF/UHF band.

## 4.2 Test conditions: immunity testing

In the case of receivers operating, or capable of operating on a number of frequencies over a wide frequency band, immunity tests shall be made over a selected number of wanted signal test frequencies. For the selected wanted signal test frequencies see subclause 4.1.1.

A communications link shall be established at the start of the test and maintained during the test. The test modulation, test arrangement etc., as specified in this ETS, subclauses 4.2.1, 4.2.2, 4.2.3, 4.2.4 and 4.2.5 shall apply and the conditions shall be as follows:

- for transmitter immunity testing under active conditions, in the case of transmitters designed to emit transmissions with a non constant envelope, the power setting may be reduced to -6 dB with respect to maximum PEP RF output. In the case of transmitters designed to emit transmissions with a constant envelope, the EUT may be operated at maximum PEP RF output, or at a level up to 6 dB lower than this in the event of declared thermal limitations;
- for stand alone receivers or receivers of transceivers operating in the simplex mode, the wanted RF input signal, coupled to the receiver, shall be modulated with a suitable test signal subclause 4.2.3;
- for duplex transceivers, the wanted RF input signal, coupled to the receiver, shall be modulated with a suitable test signal subclause 4.2.3. The transmitter shall be operated at its maximum PEP RF output, modulated with the test signal, coupled to the transmitter from the output of the receiver (repeater mode).

### 4.2.1 Arrangements for wanted signals at the modulation input of the transmitter

The transmitter should be modulated with a suitable signal, from an internal or external signal source. If it is not appropriate to provide a modulated signal from the transmitter, the test may be performed using an unmodulated carrier. It shall be possible to verify that a communications link is established and maintained.

### 4.2.2 Arrangements for monitoring the RF output of the transmitter

The measuring equipment used to monitor the output signal of the transmitter shall be located outside of the test environment. Adequate measures shall be taken to protect the measuring equipment from the effect of all interference, (e.g. radiated fields and conducted interference).

The output signal of the transmitter shall be coupled to the receiving measuring equipment via a shielded transmission line, such as a coaxial cable, to enable a communications link to be established and maintained.

In the case of a integral antenna equipment not provided with an external RF antenna connector, the output signal of the transmitter shall be coupled to another antenna located within the test environment enabling a communications link to be established and maintained. This antenna shall be coupled to the receiving measuring equipment.

### 4.2.3 Arrangements for wanted signals at the input of the receiver

The wanted input signal to the receiver should be modulated with a suitable test signal. If it is not appropriate to provide a modulated signal to the receiver, the test may be performed using an unmodulated wanted input signal. It shall be possible to verify that a communications link is established and maintained.

The wanted input signal, to establish a communications link shall be presented to the antenna connector by a coaxial cable. The source of the wanted input signal shall be located outside of the test environment and shall be at a nominal value 60 dB above the maximum usable sensitivity of the EUT as declared by the manufacturer in the product documentation.

### 4.2.4 Arrangements for monitoring the output of the receiver

The output of the receiver under test shall be coupled via a suitable coupling device in order to demonstrate that the link is maintained.

The equipment used for monitoring the maintenance of the link shall be located outside of the environment.

Adequate measures shall be taken to protect the measuring equipment from the effects of all interference (e.g. radiated fields and conducted interference).

#### **4.2.5 Receiver: exclusion band for immunity testing**

Small frequency bands centred around the radio frequency to which the radio is tuned are excluded from immunity tests with either radiated or conducted signals. These RF test exclusions are referred to as "exclusion bands".

The exclusion band for a receiver and the receiver of a transceiver is determined by the characteristics of the equipment.

In the case of receivers operating on a fixed single frequency, the exclusion band extends from minus 5 % to plus 5 % of the fixed single frequency.

In the case of receivers operating, or capable of operating, on a number of spot frequencies in a narrow operating frequency band which is less than 20 % of the centre frequency of the operating band, the exclusion band extends from minus 5 % of the lowest frequency of the narrow operating frequency band to plus 5 % of the highest frequency of that band.

In the case of receivers operating, or capable of operating on a number of spot frequencies over a wide frequency band the exclusion band for each of the wanted signal test frequencies shall extend from minus 5 % to plus 5 % of each wanted signal test frequency.

#### **4.2.6 Receiver: narrow band responses**

Responses on 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, an unwanted signal causes degradation of performance of the output resulting from the wanted signal, it is necessary to establish whether the degradation of performance is due to a narrow band response or to a wide band phenomena. Therefore, the unwanted signal frequency shall be increased by an amount equal to twice the bandwidth of the bandwidth defining filter as declared by the manufacturer. The test shall be repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation of performance disappears then the response is considered as a narrow band response.

If the degradation of performance does not disappear 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 method above is repeated with the increase and decrease of the frequency of the unwanted signal adjusted to two and a half times the bandwidth referred to. If the degradation does not now disappear, the phenomenon is considered wide band and therefore an EMC problem, and the equipment fails the test.

Narrow band responses are disregarded.

#### **4.2.7 Transmitter: exclusion band for immunity testing**

The exclusion band for transmitters for immunity testing extends  $\pm$  twice the maximum occupied bandwidth allowed for the type of service for which the equipment is intended to operate, centred around the occupied bandwidth.

### 4.3 Test conditions: emissions testing

#### 4.3.1 Transmitter: exclusion band for emissions testing

The exclusion band for transmitters for emission testing shall be determined by the class of emission characteristics of the EUT. For measurement purposes the exclusion bandwidth shall additionally allow for the skirt bandwidth ( $F_b$ ) of the measuring instrumentation, as shown in table 1.

**Table 1: Transmitter exclusion band for emissions**

Necessary bandwidth of emission	Exclusion band	Exclusion band centre
$F_n < 0,05 F_c$	$3 F_n + F_b$	$F_c$
$F_n > 0,05 F_c$	$1,1 F_n + F_b$	$F_c$

Where:

$F_n$  = Necessary bandwidth of the wanted class of emission as defined in ITU RR 1-18 clause 146 [4]

$F_b$  = 200 kHz in the frequency range below 30 MHz

$F_b$  = 2 in the frequency range above 30 MHz

$F_c$  = Centre frequency of the transmitter necessary bandwidth

## 5 Performance assessment

### 5.1 General

The manufacturer shall declare the following information which shall be properly documented:

- the primary functions of the radio equipment to be evaluated during and after the EMC testing;
- 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 method to be used to verify that a communications link is established and maintained;
- 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 during and after immunity testing;
- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as ac or dc power;
- the operating mode which produces the maximum emission for multimode equipment;
- the bandwidth of the bandwidth-defining filter used in each mode, in the case of multi-mode equipment. The antenna port immunity test (RF immunity, differential mode) shall be performed using the mode with the widest defined bandwidth.

### 5.2 Equipment classification

Amateur radio equipment and/or combinations of equipment shall be considered as either base station, and/or mobile and/or portable station by declaration of the manufacturer.

Equipment intended for use in more than one EMC environment, shall be tested with each type of declared power source under conditions simulating each declared EMC environment. For example, portable equipment declared as capable of being powered for intended use by the main battery of a vehicle, shall additionally be considered as equipment for vehicular use.

## 6 Performance criteria

Amateur radio equipment may contain user functions which are of primary relevance from the point of view of conveying information or configure the equipment to allow the exchange of information.

In addition other user functions may be included in the equipment which do not have a functional relationship with the primary function.

From the perspective of developing intrinsic immunity specifications (minimum performance criteria) the example below illustrates what are considered as primary or secondary functions.

EXAMPLE: A paging receiver also containing an alarm clock:

- primary functions are the reception of a call, the call alert and the storage of a call, if provided.
- secondary functions are all functions related to the alarm clock.

Primary user functions:

- the equipment shall meet the minimum particular performance criteria as specified in the following subclauses 6.1, 6.2, 6.3, where appropriate.

Secondary user functions:

- for secondary user functions the equipment shall meet the general performance criteria as specified in subclause 6.4.



## 6.1 General performance criteria (primary user functions)

**Table 2: General performance criteria**

Subclause	Criteria	During test	After test
6.1.1	A	Degradation of performance (note 1) No loss of function Operate as intended (no loss of link) No unintended RF transmission No loss of user control functions or stored configuration data	Operate as intended No degradation of performance (note 2) No loss of function No loss of stored data
6.1.2	B	Loss of function (one or more) No unintended RF transmission No loss of user control functions or stored configuration data	Operate as intended No degradation of performance (note 2) Functions self-recoverable No loss of link <u>after</u> test No loss of stored data
6.1.3	C	Loss of function (one or more) (and/or) user data No unintended RF transmission	Operate as intended No degradation of performance (note 2) Functions recoverable by the operator (i.e. can be reset to normal)
NOTE 1:	<p>Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		
NOTE 2:	<p>No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		

## 6.2 Particular performance criteria: (primary user functions) transmitters, receivers, transceivers, RF amplifiers and transverters

RF amplifiers and transverters shall be stimulated with signals in accordance with manufacturer's specifications.

### 6.2.1 Tests with phenomena of a continuous nature

- during and after the test there shall be no unintended transmission;
- at the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer;
- during the test the communication link shall not deteriorate below a level of 12 dB SINAD for analogue (speech) communication and the digital throughput shall not drop below 80% of the nominal throughput;

- after the test, the communications link shall not be lost, and shall not deteriorate below a level specified by the manufacturer, and the digital throughput shall return to its nominal value.

#### **6.2.2 Tests with phenomena of a transient nature**

- during and after the test there shall be no unintended transmission;
- after the test there shall be no loss of the communication link;
- it shall be permissible to re-key the transmitter after an electrostatic discharge (ESD) event;
- after the test the speech quality level shall return to a level not below that specified by the manufacturer and the digital throughput shall return to its nominal value;
- after the test there shall be no loss of user control functions and/or stored user data.

#### **6.2.3 Tests with voltage dips**

- during and after the test there shall be no unintended transmission;
- after the test there shall be no loss of the communications link;
- after the test the speech quality level shall return to a level not below that specified by the manufacturer and the digital throughput shall return to its nominal value;
- after the test there shall be no loss of user control functions and/or stored user data.

#### **6.2.4 Tests with power interruptions**

- during and after the test there shall be no unintended transmission;
- during the test the communications link may be lost and one or more functions and/or stored user data may be lost;
- after the test the communications link shall be recoverable either automatically or by operational user control as declared by the manufacturer;
- after the test the speech quality level shall return to a level not below that specified by the manufacturer and the digital throughput shall return to its nominal value.

### **6.3 Particular performance criteria: ancillary equipment**

In the case of ancillary equipment being tested separately from other equipment, the manufacturer shall declare, for proper documentation, the specification for an acceptable level of performance or degradation of performance during and/or after testing, as required by this ETS in subclause 6.1. The performance specification shall be included in the product description and documentation.

The performance criteria specified by the manufacturer shall provide, as a minimum, the same degree of immunity protection as specified in subclause 6.1.

### **6.4 General performance criteria (secondary user functions)**

The equipment shall meet the performance criteria as given in table 3 including the associated notes 1 and 2.

The performance criteria A, B and C as indicated in table 3 shall be used in the following manner:

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

**Table 3: Performance criteria (secondary user functions)**

Criteria	During test	After test
A	Operate as intended Degradation of performance (note 1) No loss of function	Operate as intended No degradation of performance (note 2) No loss of function
B	Loss of function (one or more)	Operate as intended No degradation of performance (note 2) Functions self-recoverable
C	Loss of function (one or more)	Operate as intended No degradation of performance (note 2) Functions recoverable by the operator
NOTE 1:	<p>Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>	
NOTE 2:	<p>No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>	

## 7 Applicability overview tables

### 7.1 Emissions testing

**Table 4: Emission applicability**

Equipment test requirement				
Port	Base station, ancillary and other equipment for fixed use	Mobile, ancillary and other equipment for vehicular use	Portable, ancillary and other equipment for portable use	Reference document
Enclosure	applicable	applicable	applicable	
DC power in/out	not applicable	applicable	not applicable	EN 55022 [5], CISPR 16-1 [6]
AC mains	applicable	not applicable	not applicable	EN 55022 [5]
Antenna port	applicable	applicable	applicable	

See subclause 5.2 for equipment classification.

7.2 Immunity testing

Table 5: Immunity applicability

Equipment test requirement					
Phenomenon	Port applicability	Base station, ancillary and other equipment for fixed use	Mobile equipment and ancillary and other equipment for vehicular use	Portable, ancillary and other equipment for portable use	Reference document
RF electro-Magnetic field (80 - 1 000 MHz)	Enclosure	applicable	applicable	applicable	ENV 50140 [7]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	IEC1000-4-2 [8]
Fast transients common mode	Signal and control ports, dc and ac power input ports	applicable	not applicable	not applicable	IEC 1000-4-4 [9]
RF common mode 0,15 - 80 MHz (current clamp injection)	Signal and control ports, dc and ac power input ports	applicable	applicable	applicable	ENV 50141 [10]
Transients and surges, vehicular environment	dc power input ports	not applicable	applicable	not applicable	ISO 7637 Parts 1 and 2 [13, 14]
Voltage dips and interruptions	ac mains power input ports	applicable	not applicable	not applicable	ENV 61000-4-11 [11]
Surges, common and differential mode	ac mains power input ports	applicable	not applicable	not applicable	ENV 50142 [12]
RF conducted Differential Mode	Antenna port	applicable	applicable	applicable	

See subclause 5.2 for equipment classification.

8 Test methods and limits for emission tests

8.1 Emission: antenna port

8.1.1 Definitions

This test assesses the levels of unwanted emission from the antenna port of the EUT.

8.1.2 Method of measurement

The EUT shall be connected to a 50 Ω power attenuator. The output of the power attenuator shall be connected to a measuring receiver. The measuring receiver (or spectrum analyser) shall comply with the bandwidth and detector requirements as stated below.

The transmitter shall be operated to obtain its maximum PEP RF output. A single tone or bitstream shall be used to modulate the transmitter. The manufacturer shall define the modulation with the highest content of spurious emissions.

The measuring receiver shall be tuned over the measurement frequency range and at each frequency at which a spurious component is detected, the power level shall be recorded as the conducted spurious

emission level delivered into the specified load. The measurements shall be repeated with the EUT in standby-mode and with the EUT in receive mode.

The measurement frequency range extends from 150 kHz to 12,5 GHz or  $2 \times F_c$  (table 7) if greater than 12,5 GHz, excluding the transmitter exclusion band for emissions. If spurious emissions are detected within -10dB of the specified limit between 1,5 and 4 GHz, then the measurement shall continue to 12,75 GHz. If the operating frequency of the EUT is greater than 6,375 GHz the measurement frequency range shall extend up to and including twice the maximum operating frequency.

**Table 6: Bandwidth requirements**

Frequency range	6 dB bandwidth
150 kHz - 30 MHz	9 - 10 kHz
30 - 1 000 MHz	100 -120 kHz
> 1 000 MHz	1 MHz

To improve measurement sensitivity, the measurement of narrow band spurious emission may be performed with a bandwidth smaller than the above. The total peak power of the all spurious emissions in the bandwidth above shall be used to determine whether the requirements are met. A peak detector complying with CISPR 16-1 [6] shall be used.

NOTE: the tables below are self-contained and do not need supporting text in the main body of this ETS.

**Table 7: Transmitter exclusion band for emissions**

Necessary bandwidth of emission	Exclusion band	Exclusion band centre
$F_n < 0,05 F_c$	$3 F_n + F_b$	$F_c$
$F_n > 0,05 F_c$	$1,1 F_n + F_b$	$F_c$

Where:

$F_n$  = Necessary bandwidth of the wanted class of emission as defined in ITU RR 1-18 clause 146 [4]

$F_b$  = 200 kHz in the frequency range below 30 MHz

$F_b$  = 2 MHz in the frequency range above 30 MHz

$F_c$  = Centre frequency of the transmitter necessary bandwidth

### 8.1.3 Limits: antenna port in transmitter-active mode

**Table 8: Antenna port limits in active mode**

Frequency range	Test Limits	Remarks
0,15 -1,7 MHz	- 36 dBm or -60 dBc whichever is higher	
1,7 - 35 MHz	- 36 dBm or -40 dBc whichever is higher	
35 - 50 MHz	-40 to -60 dBc (note 1) or - 36 dBm whichever is higher	
50 - 1 000 MHz	- 36 dBm or -60 dBc whichever is higher	
> 1 000 MHz	- 30 dBm or -50 dBc whichever is higher	note 2
NOTE 1:	The limit in dBc decreases linearly with the logarithm of frequency in the range 1,7 MHz to 35 MHz.	
NOTE 2:	For measurement at frequencies greater than 40 GHz no test limits are specified.	

There shall be no requirement for any individual spurious emission to be lower than -36 dBm.

**8.1.4 Limits: antenna port in standby mode****Table 9: Antenna port limits in standby mode**

Frequency Range	Test Limits	Remarks
0,15 -1 000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	note
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

**8.1.5 Limits: antenna port in receive mode****Table 10: Antenna port limits in receive mode**

Frequency Range	Test Limits	Remarks
0,15 - 1000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	note
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

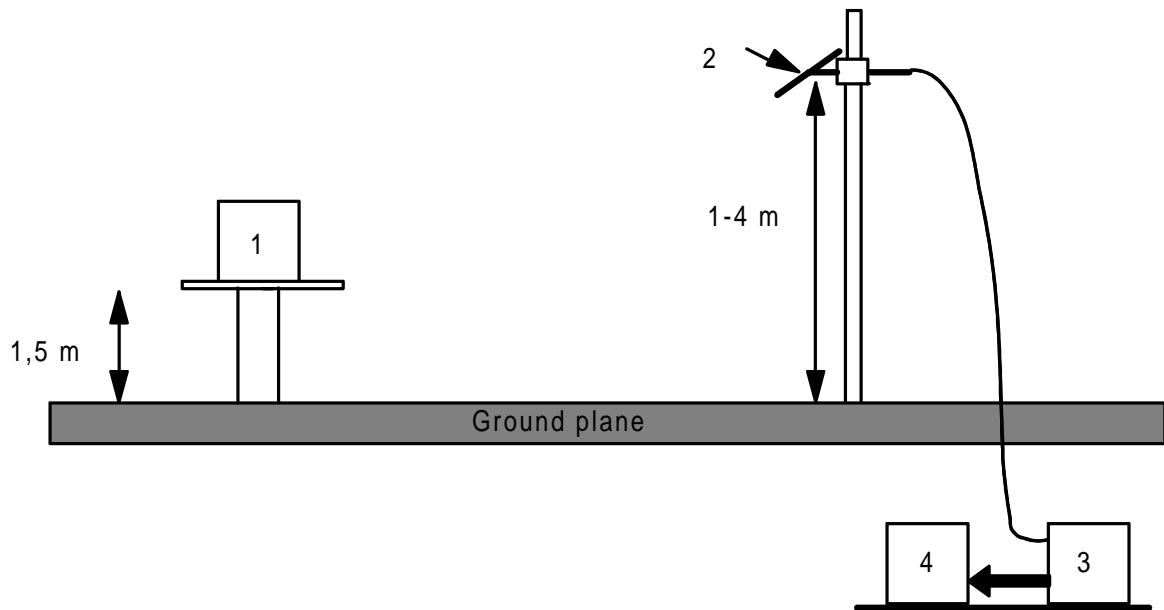
**8.2 Emissions: enclosure port****8.2.1 Definition**

This test assesses the levels of unintended emission from the enclosure port of the EUT.

**8.2.2 Method of measurement****8.2.2.1 Test sites and general arrangements for measurements involving the use of radiated fields****8.2.2.1.1 Outdoor test site**

The outdoor test site shall be on a reasonably level surface or ground. At one point on the site, a ground plane of at least 5 m diameter shall be provided. In the middle of this ground plane, a non-conducting support, capable of rotation through 360° in the horizontal plane, shall be used to support the test sample in its standard position, at 1,5 m above the ground plane. The test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of  $\lambda/2$  or 3 m whichever is the greater. The distance actually used shall be recorded with the results of the tests carried out on the site.

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site do not degrade the measurements results.



Key:

- 1) Equipment under test
- 2) Test antenna
- 3) High pass filter (may not be necessary)
- 4) Spectrum analyser or measuring receiver

**Figure 2**

#### 8.2.2.1.2 Standard position

The standard position in all test sites, shall be as follows:

- the antenna port of the EUT shall be terminated with a substantially non-reactive and non-radiating resistive load of 50  $\Omega$ .

#### 8.2.2.1.3 Test antenna

The test antenna is used to detect the radiation from the test sample, when the site is used for radiation measurements.

This antenna is mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarisation and for the height of its centre above ground to be varied over the range 1 to 4 m. Preferably a test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20 % of the measuring distance.

For receiver and transmitter radiation measurements, the test antenna is connected to a measuring receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input.

When measuring in the frequency range up to 1 GHz the test antenna shall be a  $\lambda/2$  dipole, resonant at the operating frequency, or a shortened dipole, calibrated to the  $\lambda/2$  dipole. When measuring in the frequency range above 4 GHz a horn radiator shall be used. For measurements between 1 and 4 GHz either a  $\lambda/2$  dipole or a horn radiator may be used.

The distance between the lower extremity of the dipole and the ground shall not be less than 0,3 m.

NOTE: The gain of a horn antenna is generally expressed relative to an isotropic radiator.

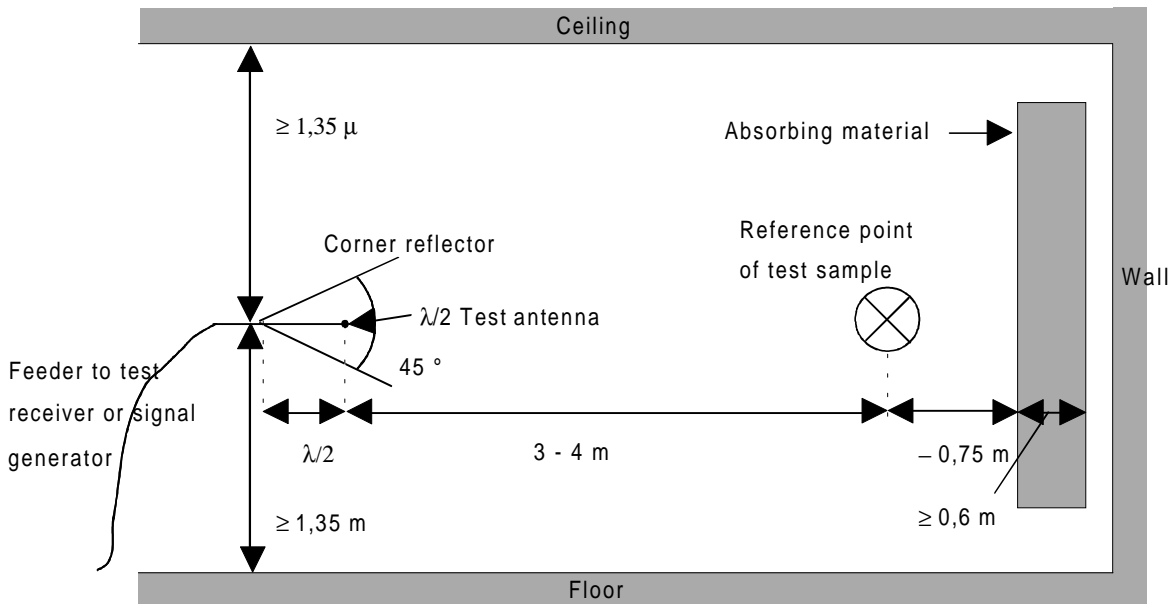
**8.2.2.1.4 Optional additional indoor site**

When the frequency of the signals being measured is greater than 80 MHz, use may be made of an indoor site. If this alternative site is used, this shall be recorded in the test report.

The measurement site may be a laboratory room with a minimum area of 6 m by 7 m and at least 2,7 m in height.

Apart from the measuring apparatus and the operator, the room shall be as free as possible from reflecting objects other than the walls, floor and ceiling.

The potential reflections from the wall behind the equipment under test are reduced by placing a barrier of absorbent material in front of it. The corner reflector around the test antenna is used to reduce the effect of reflections from the opposite wall and from the floor and ceiling in the case of horizontally polarised measurements. Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarised measurements. For the lower part of the frequency range (below approximately 175 MHz) no corner reflector or absorbent barrier is needed. For practical reasons, the  $\lambda/2$  antenna in figure 3 may be replaced by an antenna of constant length, provided that this length is between  $\lambda/4$  and  $\lambda$  at the frequency of measurement and the sensitivity of the measuring system is sufficient. In the same way the distance of  $\lambda/2$  to the apex may be varied.



**Figure 3: Indoor site arrangement (shown for horizontal polarisation)**

The test antenna and measuring receiver, are used in a way similar to that of the general method.

**8.2.2.2 Guidance on the use of radiation test sites**

For measurements involving the use of radiated fields, use may be made of a test site in conformity with the requirements of subclause 8.2.2.1. When using such a test site, the following conditions should be observed to ensure consistency of measuring results.

**8.2.2.2.1 Measuring distance**

Evidence indicates that the measuring distance is not critical and does not significantly affect the measuring results, provided that the distance is not less than  $\lambda/2$  at the frequency of measurement, and the precautions described in this clause are observed. Measuring distances of 3, 5, 10 and 30 m are in common use in European test laboratories.



#### **8.2.2.2.2 Test antenna**

Different types of test antenna may be used, since performing substitution measurements reduces the effect of the errors on the measuring results.

Height variation of the test antenna over a range of 1 to 4 m is essential in order to find the point at which the radiation is a maximum.

Height variation of the test antenna may not be necessary at the lower frequencies below about 100 MHz.

#### **8.2.2.2.3 Substitution antenna**

The substitution antenna and signal generator is used to replace the equipment under test in substitution measurements. For measurements below 1 GHz the substitution antenna shall be half wavelength dipole resonant at the frequency under consideration, or a shortened dipole, calibrated to the half wavelength dipole. For measurements between 1 and 4 GHz either a half wavelength dipole or a horn radiator may be used. For measurements above 4 GHz a horn radiator shall be used. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an outside antenna is connected to the cabinet. The distance between the lower extremity of the dipole and the ground shall be at least 300 mm.

#### **8.2.2.2.4 Auxiliary cables**

The position of auxiliary cables (power supply etc.) which are not adequately decoupled may cause variations in the measuring results. In order to get reproducible results, cables and wires of auxiliary equipment should be arranged vertically downwards (through a hole in the non conducting support).

#### **8.2.2.3 Further optional alternative indoor test site using a fully anechoic RF chamber**

For radiation measurements when the frequency of the signals being measured is greater than 30 MHz, use may be made of an indoor site being a well-shielded anechoic chamber simulating free space environment. If such a chamber is used, this shall be recorded in the test report.

The test antenna and measuring receiver, are used in a way similar to that of the general method, subclause 8.2.2.1. In the range between 30 MHz and 100 MHz some additional calibration may be necessary.

An example of a typical measurement site may be an electrically shielded anechoic chamber being 10 m long, 5 m broad and 5 m high. Walls and ceiling should be coated with RF absorbers of 1 m height. The base should be covered with absorbing material 1 m thick, and a wooden floor, able to carry test equipment and operators. A measuring distance of 3 to 5 m in the long middle axis of the chamber can be used for measurements up to 12,75 GHz. For frequencies above 12,75 GHz the chamber may be used provided it has been calibrated for use at the frequency being measured. The construction of the anechoic chamber is described in the following clauses.

##### **8.2.2.3.1 Example of the construction of a shielded anechoic chamber**

Free-field measurements can be simulated in a shielded measuring chamber where the walls are coated with RF absorbers. Figure 4 shows the requirements for shielding loss and wall return loss of such a room. As dimensions and characteristics of usual absorber materials are critical below 100 MHz (height of absorbers < 1 m, reflection attenuation < 20 dB) such a room is preferably suitable for measurements above 100 MHz. Figure 5 shows the construction of a shielded measuring chamber having a base area of 5 m by 10 m and a height of 5 m.

Ceilings and walls are coated with pyramidal formed radio frequency absorbers approximately 1 m high or equivalent material with the same performance. The base is covered with absorbers which form a non-conducting sub-floor, or with special ground floor absorbers. The available internal dimensions of the room are 3 m x 8 m x 3 m, so that a measuring distance of maximum 5 m length in the middle axis of this room is available.

At 100 MHz the measuring distance can be extended up to a maximum of  $2\lambda$ .

The floor absorbers reduce floor reflections so that the antenna height need not be changed and floor reflection influences need not be considered.

All measuring results can therefore be checked with simple calculations and the measurement uncertainties have the smallest possible values due to the simple measuring configuration.

### 8.2.2.3.2 Influence of parasitic reflections in anechoic chambers

For free-space propagation in the far field condition the correlation  $E=E_0.(R_0/R)$  is valid for the dependence of the field strength E on the distance R, whereby  $E_0$  is the reference field strength in the reference distance  $R_0$ .

It is useful to use just this correlation for comparison measurements, as all constants are eliminated with the ratio and neither cable attenuation nor antenna mismatch or antenna dimensions are of importance.

Deviations from the ideal curve can be seen easily if the logarithm of the above equation is used, because the ideal correlation of field strength and distance can then be shown as a straight line and the deviations occurring in practice are clearly visible. This indirect method shows the disturbances due to reflections more readily and is far less problematical than the direct measurement of reflection attenuation.

With an anechoic chamber of the dimensions suggested in subclause 8.2.2.3 at low frequencies up to 100 MHz there are no far field conditions, and therefore reflections are stronger so that careful calibration is necessary. In the medium frequency range from 100 MHz to 1 GHz the dependence of the field strength on the distance meets the expectations very well. In the frequency range of 1 to 40 GHz, because more reflections will occur, the dependence of the field strength on the distance will not correlate so closely.

### 8.2.2.3.3 Calibration of the shielded RF anechoic chamber

Calibration of the chamber shall be performed over the range 30 MHz to 40 GHz.

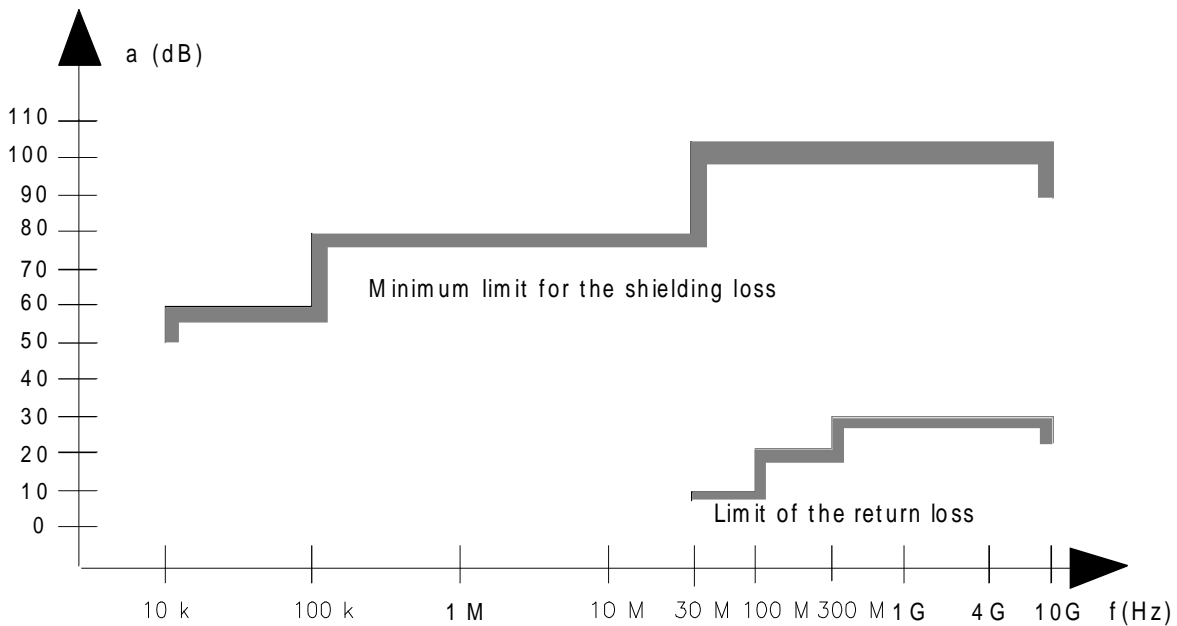
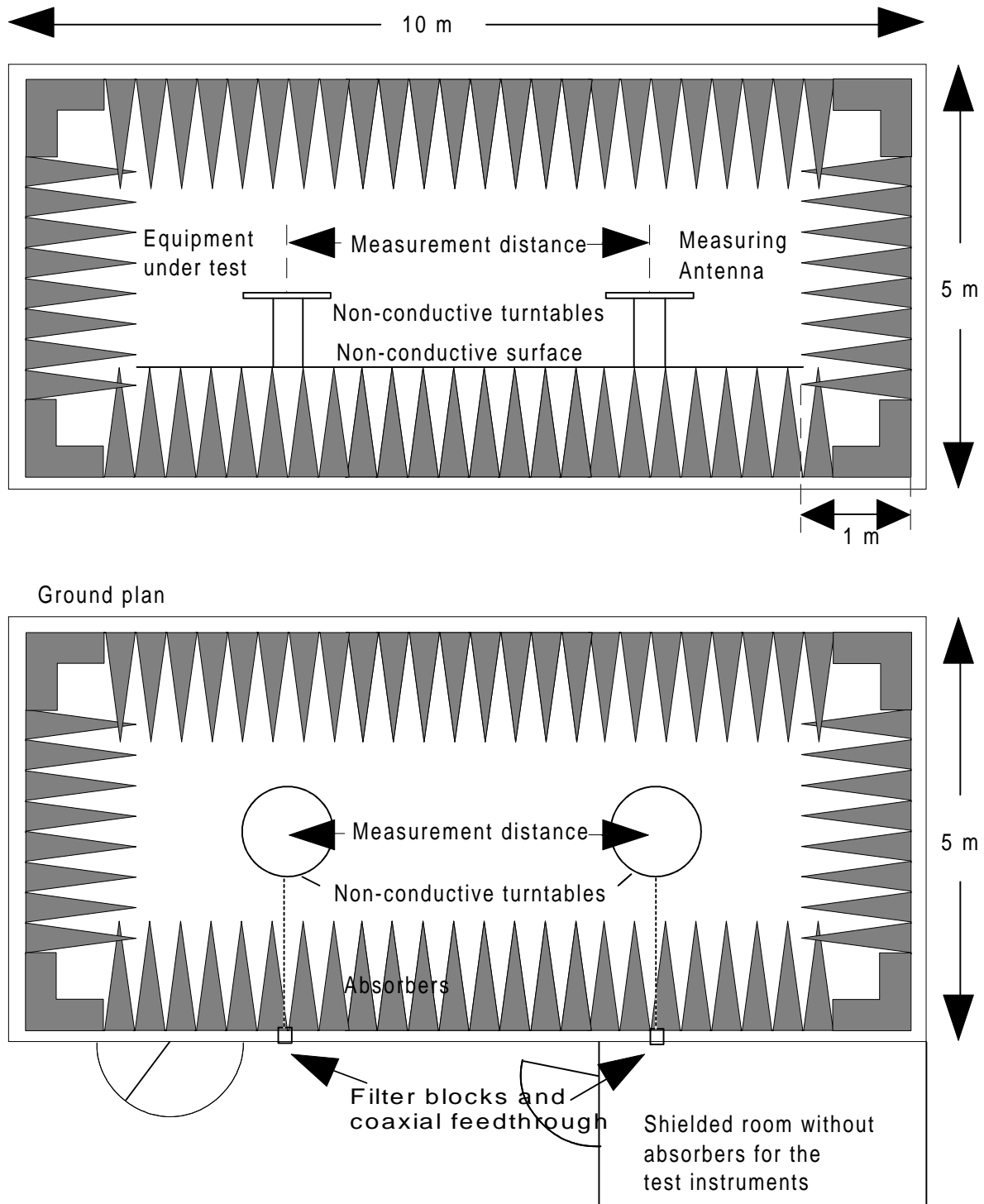


Figure 4: Specification for shielding and reflections



**Figure 5: Example of construction of an anechoic shielded chamber**

**8.2.2.4: General description of measurement methods**

This subclause gives the general methods of measurements for RF signals using the test sites and arrangements described in subclause 8.2.2.1. In addition, this subclause gives a simple measurement method for radiated emissions based on a calculated rather than measured path loss.

**8.2.2.4.1 Radiated measurements**

Radiated measurements shall be performed with the aid of a test antenna and measurement receiver as described in subclause 8.2.2.1. The test antenna and measurement receiver, spectrum analyser or selective voltmeter, shall be calibrated according to the procedure defined in this subclause.

The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level. This position shall be recorded in the measurement report. The frequency range shall be measured in this position.

Preferably, radiated measurements shall be performed in an anechoic chamber. For other test sites corrections may be needed subclause 8.2.2.1.

- a) a test site which fulfils the requirements of the specified frequency range of this measurement shall be used;
- b) the transmitter under test shall be placed on the support in its standard position subclause 8.2.2.1.2 and switched on;
- c) the test antenna shall be oriented initially for vertical polarization unless otherwise stated. The test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the measuring receiver;

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to subclause 8.2.2.3.

- d) the transmitter shall be rotated through 360° about a vertical axis to maximise the received signal;
- e) the test antenna shall be raised or lowered again, if necessary, through the specified height range until a maximum is obtained. This level shall be recorded;

(This maximum may be a lower value than the value obtainable at heights outside the specified limits).

- f) this measurement shall be repeated for horizontal polarization;
- g) the substitution antenna shall replace the transmitter antenna in the same position and in vertical polarization. The frequency of the signal generator shall be adjusted to the transmitter (carrier) frequency;
- h) steps c) to f) shall be repeated;
- j) the input signal to the substitution antenna shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver;
- k) this measurement shall be repeated with horizontal polarization;
- l) the radiated power is equal to the power supplied by the signal generator, increased by the known relationship if necessary and after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna.

The transmitter shall be operated to obtain its maximum RF output PEP. A single tone or bitstream shall be used to modulate the transmitter. The manufacturer shall define the modulation with the highest content of spurious emissions.

The measurement frequency range extends from 30 MHz to 12,5 GHz or  $2 \times F_c$  if greater than 12,5 GHz, excluding the transmitter exclusion band for emissions. If spurious emissions are detected within -10dB of the specified limit between 1,5 and 4 GHz, then the measurement shall continue to 12,75 GHz. If the operating frequency of the EUT is greater than 6,375 GHz the measurement frequency range shall extend up to and including twice the maximum operating frequency.

**Table 11: Bandwidth requirements**

<b>Frequency range</b>	<b>6 dB Bandwidth</b>
30 - 1 000 MHz	100 -120 kHz
> 1 000 MHz	1 MHz

To improve measurement sensitivity, the measurement of narrow band spurious emissions may be performed with a bandwidth smaller than the above. The total peak power of the all spurious emissions in

the bandwidth above shall be used to determine whether the requirements are met. A peak detector complying with CISPR 16-1 [6] shall be used.

**Table 12: Transmitter exclusion band for emissions**

Necessary bandwidth of emission	Exclusion band	Exclusion band centre
$F_n < 0,05 F_c$	$3 F_n + F_b$	$F_c$
$F_n > 0,05 F_c$	$1,1 F_n + F_b$	$F_c$

Where:

$F_n$  = Necessary bandwidth of the wanted class of emission as defined in ITU RR 1-18 clause 146 [4]

$F_b$  = 200 kHz in the frequency range below 30 MHz

$F_b$  = 2 MHz in the frequency range above 30 MHz

$F_c$  = Centre frequency of the transmitter necessary bandwidth

### 8.2.3 Limits: transmitter active mode

**Table 13: Enclosure port limits in active mode**

Frequency range	Test limits	Remarks
30 - 35 MHz	- 36 dBm or -40 dBc whichever is higher	
35 - 50 MHz	-40 to -60 dBc (note 1) or - 36 dBm whichever is higher	
50 - 1 000 MHz	- 36 dBm or -60 dBc whichever is higher	
> 1 000 MHz	- 30 dBm or -50 dBc whichever is higher	note 2
NOTE 1: The limit in dBc decreases linearly with the logarithm of frequency in the range 35 MHz to 50 MHz.		
NOTE 2: For measurement at frequencies greater than 40 GHz no test limits are specified.		

Where limits are stated using dBc the reference level is the maximum RF output PEP of the transmitter measured at the antenna port.

### 8.2.4 Limits: standby mode

**Table 14: Enclosure port limits in receive mode**

Frequency Range	Test Limits	Remarks
30-1 000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	note
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

### 8.2.5 Limits: receive mode

**Table 15: Limits: receive mode**

Frequency Range	Test Limits	Remarks
30-1 000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	note
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

### 8.3 Emission: dc power input/output port

#### 8.3.1 Definition

This test assesses the ability of ancillary equipment, receivers, transmitters or transceivers, transverters, RF amplifiers and modems to limit its internal noise from being present on the dc power input/output ports.

#### 8.3.2 Method of measurement

The test method shall be in accordance with EN 55022 [5].

For equipment with a current consumption below 16 A the test method shall be in accordance with EN 55022 [5] and the Line Impedance Stabilising 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  $\Omega$  measurement ports. The LISNs shall be in accordance with the requirements of section 2 of CISPR 16-1 [6].

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 the measurement shall be terminated with a 50  $\Omega$  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.

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

The measurement shall be performed with the transmitter in transmit mode or standby mode.

The transmitter shall be operated to obtain its maximum RF output PEP. A single tone or bitstream shall be used to modulate the transmitter. The manufacturer shall define the modulation with the highest content of spurious emissions.

The measurement frequency range extends from 150 kHz to 30 MHz, excluding the transmitter exclusion band for emissions measured in the transmit mode.

**Table 16: Transmitter exclusion band for emissions**

Necessary bandwidth of emission	Exclusion band	Exclusion band centre
$F_n < 0,05 F_c$	$3 F_n + F_b$	$F_c$
$F_n > 0,05 F_c$	$1,1 F_n + F_b$	$F_c$

Where:

$F_n$  = Necessary Bandwidth of the wanted emission as defined in ITU RR 1-18 clause 146 [4]

$F_b$  = 200 kHz in the frequency range below 30 MHz

$F_c$  = Centre - frequency of the transmitter necessary bandwidth

## 8.3.3 Limits: transmitter active mode

Table 17: DC power port limits in active mode

Environmental phenomena	Frequency range	Test limits	Basic standard
Conducted emission	0,15 - 0,5 MHz	66-56 dB $\mu$ V quasi peak 56-46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	0,5 - 5 MHz	56 dB $\mu$ V quasi peak 46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	5 - 30 MHz	60 dB $\mu$ V quasi peak 50 dB $\mu$ V average	EN 55022 [5]
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port intended for use with a dedicated ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter as specified by the manufacturer.			

## 8.3.4 Limits: standby mode

Table 18: DC power port limits in standby mode

Environmental phenomena	Frequency range	Test limits	Basic standard
Conducted emission	0,15 - 0,5 MHz	66-56 dB $\mu$ V quasi peak 56-46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	0,5 - 5 MHz	56 dB $\mu$ V quasi peak 46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	5 - 30 MHz	60 dB $\mu$ V quasi peak 50 dB $\mu$ V average	EN 55022 [5]
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port intended for use with a dedicated ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter as specified by the manufacturer.			

## 8.3.5 Limits: receive mode

Table 19: DC power port limits in receive mode

Environmental phenomena	Frequency range	Test limits	Basic standard
Conducted emission	0,15 - 0,5 MHz	66-56 dB $\mu$ V quasi peak 56-46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	0,5 - 5 MHz	56 dB $\mu$ V quasi peak 46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	5 - 30 MHz	60 dB $\mu$ V quasi peak 50 dB $\mu$ V average	EN 55022 [5]
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port intended for use with a dedicated ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter as specified by the manufacturer.			

## 8.4 Emission: ac mains power input/output port

### 8.4.1 Definition

This test assesses the ability of ancillary equipment, receivers, transmitters or transceivers, transverters, RF amplifiers and modems to limit their internal noise from being present on the ac mains power input/output ports.

### 8.4.2 Method of measurement:

The conducted measurement method from EN 55022 [5] shall be used.

The measurement shall be performed with the transmitter in transmit mode or standby mode.

The transmitter shall be operated to obtain its maximum RF output PEP. A single tone or bit stream shall be used to modulate the transmitter. The manufacturer shall define the modulation with the highest content of spurious emissions.

The measurement frequency range extends from 150 kHz to 30 MHz, excluding the transmitter exclusion band for emissions when measured in the transmit mode.

**Table 20: Transmitter exclusion band for emissions**

Necessary bandwidth of emission	Exclusion band	Exclusion band-centre
$F_n < 0,05 F_c$	$3 F_n + F_b$	$F_c$
$F_n > 0,05 F_c$	$1,1 F_n + F_b$	$F_c$

Where:

$F_n$  = Necessary Bandwidth of the wanted emission as defined in ITU RR 1-18 clause 146 [4]

$F_b$  = 200 kHz in the frequency range below 30 MHz

$F_c$  = Centre - frequency of the transmitter necessary bandwidth

### 8.4.3 Limits: transmit active mode

**Table 21: AC mains port limits in active mode**

Environmental phenomena	Frequency range	Test limits	Basic standard
Conducted emission	0,15 - 0,5 MHz	66-56 dB $\mu$ V quasi peak 56-46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	0,5 - 5 MHz	56 dB $\mu$ V quasi peak 46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	5 - 30 MHz	60 dB $\mu$ V quasi peak 50 dB $\mu$ V average	EN 55022 [5]
NOTE:	The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port intended for use with a dedicated ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter as specified by the manufacturer.		



#### 8.4.4 Limits: standby mode

**Table 22: AC mains port limits in standby mode**

Environmental Phenomena	Frequency Range	Test Limits	Basic Standard
Conducted emission	0,15 - 0,5 MHz	66-56 dB $\mu$ V quasi peak 56-46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	0,5 - 5 MHz	56 dB $\mu$ V quasi peak 46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	5 - 30 MHz	60 dB $\mu$ V quasi peak 50 dB $\mu$ V average	EN 55022 [5]
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port intended for use with a dedicated ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter as specified by the manufacturer.			

#### 8.4.5 Limits: receive mode

**Table 23: AC mains port limits in receive mode**

Environmental phenomena	Frequency range	Test limits	Basic standard
Conducted emission	0,15 - 0,5 MHz	66-56 dB $\mu$ V quasi peak 56-46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	0,5 - 5 MHz	56 dB $\mu$ V quasi peak 46 dB $\mu$ V average	EN 55022 [5]
Conducted emission	5 - 30 MHz	60 dB $\mu$ V quasi peak 50 dB $\mu$ V average	EN 55022 [5]
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port intended for use with a dedicated ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter as specified by the manufacturer.			

## 9 Test methods and levels for immunity tests

### 9.1 Test configuration

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

- the measurement shall be made in the 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, transmitter or transceiver coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails;
- the configuration and mode(s) of operation during measurements shall be properly recorded;
- 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 tests shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment.

### 9.1.1 Arrangement for test signals in receive mode

A wanted signal and an unwanted signal shall be combined by a suitable combining network and presented to the antenna connector of the EUT with a level specified in the tables.

The wanted signal shall be at operating frequencies chosen according to subclause 4.1.1.

**Table 24: Test signals in receive mode**

Mode	Level of the wanted signal	Units / modulation
AM	40	dB $\mu$ V emf % AM (1 kHz)
	60	
FM	40	dB $\mu$ V emf % of the maximum permissible frequency deviation (1 kHz)
	60	
SSB	40	dB $\mu$ V emf unmodulated carrier
Other modes	60 dB above maximum usable sensitivity (subclause 4.2.3)	as declared by the manufacturer

## 9.2 Immunity: antenna port, RF conducted

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

This test shall not apply to RF low-noise masthead preamplifiers.

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

### 9.2.1 Definition

This test assesses the ability of receivers, transmitters, transceivers, transverters, RF amplifiers to operate as intended in the presence of a radio frequency conducted disturbance at the antenna port.

### 9.2.2 Method of measurement: transmitter active mode

In normal use amateur radio transmitting equipment is not colocated with other radio transmitters operating within 10% of its own carrier frequency, so that inter-transmitter intermodulation will not occur. Therefore immunity testing of the transmitter antenna port is not justified and is not included in this ETS.

### 9.2.3 Receive mode

#### 9.2.3.1 Method of measurement

The two input signals shall be connected to the receiver via a combining network.

Test signal sources which are applied to the receiver shall present an impedance of 50  $\Omega$  to the receiver input. This requirement shall be met irrespective whether one or more signals using a combining network are applied to the receiver simultaneously.

The levels of the test signals shall be expressed in terms of the e.m.f. at the receiver input connector.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

The wanted test signal, at the nominal frequency of the receiver, with normal test modulation, table 24, shall be applied to the receiver input connector via one input of the combining network.

For analogue communication (speech):

Where possible, the receiver volume control shall be adjusted to give at least 50 % of the rated output power or, in the case of stepped volume controls, to the first step that provides an output power of at least 50 % of the rated output power.

The rated audio output power shall be the maximum power, declared by the manufacturer for which all the requirements of this ETS are met. With normal test modulation, the audio output power shall be measured in a resistive load simulating the load with which the receiver normally operates. The value of this load shall be declared by the manufacturer. The obtained audio output level shall be noted.

For non-speech communication:

The modulation facilities shall be declared by the manufacturer.

The test shall be performed over the frequency range 150 kHz to 1 GHz using stepped increments of maximum 1 % of the momentary frequency with the exception of the exclusion band defined in subclause 4.2.5.

The test shall be applied to the receiver input connector via the second input of the combining network.

The amplitude of the unwanted test signal shall be adjusted given in subclause 9.2.3.2.

### 9.2.3.2 Arrangement for test signals

A wanted signal and a test signal shall be combined by a suitable combining network and presented to the antenna connector of the EUT with the level specified in table 25.

**Table 25: Antenna port levels in receive mode**

Environmental phenomena	Operating frequency range of EUT	Characteristics of the unwanted signal	Units	Performance criteria
RF conducted immunity	< 30 MHz	90 80 0,15 - 1 000	dB $\mu$ V emf % AM (400 Hz) MHz	subclause 6.2.1, A
	> 30 MHz	80 80 0,15 - 1 000		subclause 6.2.1, A

If the bandwidth of the bandwidth defining filter of the EUT is greater than 1 % of the momentary frequency, then the frequency increment may be increased to twice the value of the declared bandwidth.

The EUT shall fulfil the performance criteria A according to subclause 6.2.1.

Narrow band responses according to subclause 4.2.6 shall be disregarded.

The test system shall be properly documented.

## 9.3 Immunity: enclosure port

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

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 or a representative configuration of the ancillary equipment tested in isolation.

### 9.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers, RF amplifiers, transverters and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic field and electrostatic discharges at the enclosure.

**9.3.2 Transmitter active mode**

**9.3.2.1 Method of measurements: RF immunity**

The test method shall be in accordance with ENV 50140 [7] except that the following requirements and evaluation of test results shall apply:

The test shall be performed over the frequency range 80 MHz - 1 GHz with the exception of an exclusion band for transmitters, (subclause 4.3.1 ).

**9.3.2.2 Levels: RF immunity**

**Table 26: Enclosure port levels in active mode**

Environmental phenomena	Test limits	Units	Basic standard	Performance criteria
RF electromagnetic field	80-1000 3 80	MHz V/m(rms) unmod. %AM (400Hz)	ENV 50140 [7]	subclause 6.2.1, A

**9.3.2.3 Method of measurement: electrostatic discharge**

The test method shall be in accordance with IEC 1000-4-2 [8].

**9.3.2.4 Levels: electrostatic discharge**

**Table 27: Enclosure port levels in active mode**

Environmental phenomena	Test limits	Units	Basic standard	Performance criteria
Electrostatic discharge	4 (Contact discharge) 8 (Air discharge)	kV(charge voltage)	IEC 1000-4-2 [8]	subclause 6.2.2, B

**9.3.3 Standby and receive mode**

**9.3.3.1 Method of measurement: RF immunity**

The test method shall be in accordance with ENV 50140 [7] except that the following requirements and evaluation of test results shall apply:

On receivers the test shall be performed over the frequency range 80 MHz - 1 GHz with the exception of an exclusion band (subclause 4.2.5).

**9.3.3.2 Levels: RF immunity**

**Table 28: Enclosure port levels in standby or receive mode**

Environmental phenomena	Test limits	Units	Basic standard	Performance criteria
RF electromagnetic field	80-1000 3 80	MHz V/m(rms) unmod. %AM (400Hz)	ENV 50140 [7]	subclause 6.2.1, A

**9.3.3.3 Method of measurement: electrostatic discharge**

The test method shall be in accordance with IEC 1000-4-2 [8].

**9.3.3.4 Levels: electrostatic discharge**

**Table 29: Enclosure port levels in standby or receive mode**

<b>Environmental phenomena</b>	<b>Test limits</b>	<b>Units</b>	<b>Basic standard</b>	<b>Performance criteria</b>
Electrostatic discharge	4 (Contact discharge) 8 (Air discharge)	kV(charge voltage)	IEC 1000-4-2 [8]	subclause 6.2.2, B

**9.4 Immunity: dc power input / output port**

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

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 or a representative configuration of the ancillary equipment tested in isolation.

**9.4.1 Definition**

This test assesses the ability of transmitters, receivers, transceivers, RF amplifiers, transverters and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic disturbance and in the event of fast transients on the dc power input / output port.

**9.4.2 Transmitter active mode**

**9.4.2.1 Method of measurement: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection)**

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- this test shall be performed dc power input / output ports, which may have cables 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 stated above, a list of dc ports which were not tested shall be properly documented;
- this test shall be performed on a representative configuration of the radio equipment or a representative combination of radio and ancillary equipment.

**9.4.2.2 Levels: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection)**

**Table 30: DC power port levels in active mode**

<b>Environmental phenomena</b>	<b>Units</b>	<b>Test limits</b>	<b>Basic standard</b>	<b>Remarks</b>	<b>Performance criteria</b>
Radio frequency common mode	MHz V(rms,unmod) %A M (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A

NOTE: The test level can be defined as the equivalent current into a 150 Ω load.

**9.4.2.3 Method of measurement: fast transients common mode**

For transmitters, receivers, transceivers and ancillary equipment, which may have longer cables than 3 m, the test method shall be in accordance with IEC 1000-4-4 [9].

This test is applicable to base station equipment and ancillary equipment.

This test shall be performed on dc power input ports 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 properly documented.

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.

#### 9.4.2.4 Levels: fast transients common mode

Table 31: DC power port levels in active mode

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Fast transients common mode	kV(peak) ns (Tr/Th) kHz (rep.freq.)	0,5 5/50 5	IEC 1000-4-4 [9]	note	subclause 6.2.2, B
NOTE: Not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the equipment for recharging. Equipment with a dc power input port intended for use with an ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter.					

#### 9.4.3 Standby and receive mode

##### 9.4.3.1 Method of measurement: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- this test shall be performed dc power input / output ports, which may have cables 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 stated above, a list of dc ports which were not tested shall be properly documented;
- this test shall be performed on a representative configuration of the radio equipment or a representative combination of radio and ancillary equipment.

##### 9.4.3.2 Levels: RF immunity, common mode, 0,15 MHz - 80 MHz (current clamp injection)

Table 32: DC power port levels in standby or receive mode

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %A M (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A
NOTE: The test level can be defined as the equivalent current into a 150 Ω load.					

##### 9.4.3.3 Method of measurement: fast transients common mode

For transmitters, receivers, transceivers and ancillary equipment, which may have cables longer than 3 m, the test method shall be in accordance with IEC 1000-4-4 [9] this test is applicable to base station equipment and ancillary equipment, this test shall be performed on dc power input ports 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 properly documented, 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.

#### 9.4.3.4 Levels: fast transients common mode

**Table 33: DC power port levels in standby or receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Fast transients common mode	kV(peak) ns (Tr/Th) kHz (rep.freq.)	0,5 5/50 5	IEC 1000-4-4 [9]	note	subclause 6.2.2, B
NOTE: Not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the equipment for recharging. Equipment with a dc power input port intended for use with an ac-dc power adapter shall be tested on the ac power input of a typical ac-dc power adapter.					

#### 9.5 Immunity: ac power input / output port

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

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 or a representative configuration of the ancillary equipment tested in isolation.

##### 9.5.1 Definition

This test assesses the ability of transmitters, receivers, transceivers, RF amplifiers, transverters and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic disturbance (current clamp injection) and in the event of fast transients and surges common and differential mode and voltage dips and interruptions on the ac power input / output port.

##### 9.5.2 Transmitter active mode

###### 9.5.2.1 Method of measurement: RF electromagnetic disturbance common mode, 0,15 - 80 MHz (current clamp injection)

- the test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:
- the test shall be performed over the frequency range 150 kHz - 80 MHz.

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

###### 9.5.2.2 Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)

**Table 34: AC mains port levels in active mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %AM (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A
NOTE: The test level can be defined as the equivalent current into a 150 Ω load.					

###### 9.5.2.3 Method of measurement: fast transients common mode

For transmitters, receivers, transceivers and ancillary equipment intended for connection to the ac mains, the test method shall be in accordance with IEC 1000-4-4 [9].

This test is applicable to base station equipment and ancillary equipment.

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

**9.5.2.4 Levels: fast transients common mode**

**Table 35: AC mains port levels in active mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Fast transients common mode	kV(peak) Tr/Th ns kHz rep.fre.	1 5/50 5	IEC 1000-4-4 [9]	subclause 6.2.2, B

**9.5.2.5 Method of measurement: surges common and differential mode**

The test method shall be in accordance with ENV 50142 [12].

These tests are applicable to base station and fixed ancillary equipment.

These tests shall be performed on ac mains power input ports only.

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

**9.5.2.6 Levels: surges common and differential mode**

**Table 36: AC mains port levels in active mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Surges common mode	Tr/Th $\mu$ s kV (peak)	1,2/50 (8/20) 0,5	ENV 50142 [12]	subclause 6.2.2, B
Surges differential mode (line to line).	Tr/Th $\mu$ s kV (peak)	1,2/50 (8/20) 0,5	ENV 50142 [12]	subclause 6.2.2, B

**9.5.2.7 Method of measurement: voltage dips and power interruptions**

The test method shall be in accordance with EN 6 1 000-4-11 [11].

These tests are applicable to base station and fixed ancillary equipment.

These tests shall be performed on ac mains power input ports only.

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



### 9.5.2.8 Levels: voltage dips and power interruptions

**Table 37: AC mains port levels in active mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Voltage dips	% reduction ms	30 10	EN 61000-4-11 [11]	B
	% reduction ms	60 100		subclause 6.2.4, C
Power interruptions	% reduction ms	>95 5 000	EN 61000-4-11 [11]	subclause 6.2.4, C

### 9.5.3 Standby mode

#### 9.5.3.1 Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- this test shall be performed on a representative configuration of the radio equipment or a representative combination of radio and ancillary equipment.

#### 9.5.3.2 Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)

**Table 38: AC mains port levels in standby mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %A M (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A
NOTE: The test level can be defined as the equivalent current into a 150 Ω load.					

#### 9.5.3.3 Method of measurement: fast transients common mode

For transmitters, receivers, transceivers and ancillary equipment intended for connection to the ac mains, the test method shall be in accordance with IEC 1000-4-4 [9].

This test is applicable to base station equipment and ancillary equipment.

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

#### 9.5.3.4 Levels: fast transients common mode

**Table 39: AC mains port levels in standby mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Fast transients common mode	kV(peak) Tr/Th ns kHz rep.fre.	1 5/50 5	IEC 1000-4-4 [9]	subclause 6.2.2, B

#### 9.5.3.5 Method of measurement: surges common and differential mode

The test method shall be in accordance with ENV 50142 [12].

These tests are applicable to base station and fixed ancillary equipment.

These tests shall be performed on ac mains power input ports only.

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

#### 9.5.3.6 Levels: surges common and differential mode

**Table 40: AC mains port levels in standby mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Surges common mode	Tr/Th $\mu$ s kV (peak)	1,2/50 (8/20) 0,5	ENV 50142 [12]	subclause 6.2.2, B
Surges differential mode (line to line).	Tr/Th $\mu$ s kV (peak)	1,2/50 (8/20) 0,5	ENV 50142 [12]	subclause 6.2.2, B

#### 9.5.3.7 Method of measurement: voltage dips and power interruptions

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

These tests are applicable to base station and fixed ancillary equipment.

These tests shall be performed on ac mains power input ports only.

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

#### 9.5.3.8 Levels: voltage dips and power interruptions

**Table 41: AC mains port levels in standby mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Voltage dips	% reduction	30	EN 61000-4-11 [11]	B
	ms	10		
Power interruptions	% reduction	60	EN 61000-4-11 [11]	subclause 6.2.4, C
	ms	100		
Power interruptions	% reduction	>95	EN 61000-4-11 [11]	subclause 6.2.4, C
	ms	5 000		

#### 9.5.4 Receive mode

##### 9.5.4.1 Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply.

- the test shall be performed over the frequency range 150 kHz - 80 MHz.

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

**9.5.4.2 Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)****Table 42: AC mains port levels in receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %AM (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A
NOTE: The test level can be defined as the equivalent current into a 150 $\Omega$ load.					

**9.5.4.3 Method of measurement: fast transients common mode**

For transmitters, receivers, transceivers and ancillary equipment intended for connection to the ac mains, the test method shall be in accordance with IEC 1000-4-4 [9]

This test is applicable to base station equipment and ancillary equipment.

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

**9.5.4.4 Levels: fast transients common mode****Table 43: AC mains port levels in receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Fast transients common mode	kV(peak) Tr/Th ns Rep.Fre kHz	1 5/50 5	IEC 1000-4-4 [9]	Capacitive clamp to be used	subclause 6.2.2, B

**9.5.4.5 Method of measurement: surges common and differential mode**

The test method shall be in accordance with ENV 50142 [12].

These tests are applicable to base station and fixed ancillary equipment.

These tests shall be performed on ac mains power input ports only;

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

**9.5.4.6 Levels: surges common and differential mode****Table 44: AC mains port levels in receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Surges common mode	Tr/Th $\mu$ s kV (peak)	1,2/50 (8/20) 0,5	ENV 50142 [12]	subclause 6.2.2, B
Surges differential mode (line to line).	Tr/Th $\mu$ s kV (peak)	1,2/50 (8/20) 0,5	ENV 50142 [12]	subclause 6.2.2, B

**9.5.4.7 Method of measurement: voltage dips and power interruptions**

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

These tests are applicable to base station and fixed ancillary equipment.

These tests shall be performed on ac mains power input ports only.

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

#### 9.5.4.8 Levels: voltage dips and power interruptions

**Table 45: AC mains port levels in receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
Voltage dips	% reduction	30	EN 61000-4-11 [11]	B
	ms	10		
	% reduction	60		subclause 6.2.4, C
	ms	100		
Power interruptions	% reduction	>95	EN 61000-4-11 [11]	subclause 6.2.4, C
	ms	5 000		

### 9.6 Immunity: signal/control input/output port

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

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

#### 9.6.1 Definition

This test assesses the ability of transmitters, receivers, transceivers, RF amplifiers, transverters and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic disturbance and in the event of fast transients on the signal/control input/output port.

#### 9.6.2 Transmitter active mode

##### 9.6.2.1 Method of measurement: RF electromagnetic disturbance common mode, 0,15 - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:

- The test shall be performed over the frequency range 150 kHz - 80 Mhz;
- This test shall be performed on signal /control input/output ports, which may have cables 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 stated above, a list of signal/control input/output ports which were not tested for this reason shall be properly documented.

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.

**9.6.2.2 Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)****Table 46: Signal/control port levels in active mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %AM (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A
NOTE: The test level can be defined as the equivalent current into a 150 Ω load.					

**9.6.2.3 Method of measurement: fast transients common mode**

For transmitters, receivers, transceivers and ancillary equipment, which may have longer cables than 3 m, the test method shall be in accordance with IEC 1000-4-4 [9].

This test is applicable to base station equipment and ancillary equipment.

This test shall be performed on a signal/control input/output port 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 properly documented.

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

**9.6.2.4 Levels: fast transients common mode****Table 47: Signal/control port levels in active mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Fast transient common mode	kV (peak) Tr/Th ns Rep frq kHz	0.5 5/50 5	IEC 1000-4-4 [9]	Capacitive clamp to be used	subclause 6.2.2, B

**9.6.3 Standby mode****9.6.3.1 Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)**

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- this test shall be performed on Signal/control input/output ports, which may have cables 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 stated above, a list of signal/control input/output ports which were not tested for this reason shall be properly documented.

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.

**9.6.3.2 Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)**

**Table 48: Signal/control port levels in standby mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %A M (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A

NOTE: The test level can be defined as the equivalent current into a 150 Ω load.

**9.6.3.3 Method of measurement: fast transients common mode**

For transmitters, receivers, transceivers and ancillary equipment, which may have longer cables than 3 m, the test method shall be in accordance with IEC 1000-4-4 [9].

This test is applicable to base station equipment and ancillary equipment.

This test shall be performed on a Signal/control input/output port 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 properly documented.

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

**9.6.3.4 Levels: fast transients common mode**

**Table 49: Signal/control port levels in standby mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Fast transient common mode	kV (peak) Tr/Th ns Rep frq kHz	0.5 5/50 5	IEC 1000-4-4 [9]	Capacitive clamp to be used	subclause 6.2.2, B

**9.6.4 Receive mode**

**9.6.4.1 Method of measurement: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)**

The test method shall be the current clamp injection method in accordance with ENV 50141 [10], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz.

This test shall be performed on signal/control input/output ports, which may have cables 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 stated above, a list of signal/control input/output ports which were not tested for this reason shall be properly documented.

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.

**9.6.4.2 Levels: RF immunity common mode, 0,15 - 80 MHz (current clamp injection)****Table 50: Signal/control port levels in receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Radio frequency common mode	MHz V(rms,unmod) %A M (400Hz)	0,15 - 80 3 80	ENV 50141 [10]	note	subclause 6.2.1, A
NOTE: The test level can be defined as the equivalent current into a 150 Ω load.					

**9.6.4.3 Method of measurement: fast transients common mode**

For transmitters, receivers, transceivers and ancillary equipment, which may have longer cables than 3 m, the test method shall be in accordance with IEC 1000-4-4 [9].

This test is applicable to base station equipment and ancillary equipment.

This test shall be performed on a signal/control input/output port 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 properly documented.

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

**9.6.4.4 Levels: fast transients common mode****Table 51: Signal/control port levels in receive mode**

Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
Fast transients common mode	kV(peak) Tr/Th ns Rep.Fre kHz	1 5/50 5	IEC 1000-4-4 [9]	Capacitive clamp to be used	subclause 6.2.2, B

**9.7 Immunity: vehicle dc power interface port**

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

Performance criteria B and subclause 6.2.2 shall be applied for the tests in this subclause.

**9.7.1 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.

**9.7.2 Method of measurement**

The test method shall be in accordance with ISO 7637 part 1 [13] applicable to 12 V dc operated equipment and ISO 7637 part 2 [14] applicable to 24 V dc operated equipment except that the following requirements and evaluation of test results shall apply:

- equipment designed to operate at both 12 V and 24 V dc without component change, module change or adjustment shall be tested according to subclause 9.7.4;
- equipment designed to operate at both 12 V and 24 V dc but with component change, module change or adjustment shall be tested according to subclause 9.7.3 and subclause 9.7.4.

### 9.7.3 Immunity levels: 12 V dc powered equipment

Where the manufacturer in his installation documentation requires that the equipment shall have a direct connection to the 12 V main vehicle battery the following pulses apply:

**Table 52: 12 V DC power port levels**

Pulse	Level	Pulses	Characteristics	Test time
3a	II	5	see ISO 7637-1 [13]	5 min.
3b	II	5	see ISO 7637-1 [13]	5 min.
4	II	5	Vs= -5V Va= -2,5V t6=25ms, t8=5s, tf=5ms	5 min.

Where the manufacturer does not require a direct connection to the 12 V main vehicle battery, the pulses in table 53 apply, in addition to those in table 52.

**Table 53: Additional levels: 12 V dc power port**

Pulse	Level	Pulses	Characteristics	Test time
1	II	10	t1= 2,5s	
2	II	10	t1=2,5s	
7	II	5		

Where the tests for pulses 1, 2 and 7 are not performed because the manufacturer declares that the equipment requires a direct connection to the vehicle battery, this fact shall be properly documented.

### 9.7.4 Immunity levels: 24 V dc powered equipment

The test shall be carried out in accordance with ISO 7637 part 2 except where stated in this subclause.

Where the manufacturer in his installation documentation requires that the equipment shall to have a direct connection to the 24 V main vehicle battery the following pulses in table 54 apply.

**Table 54: 24 V dc power port levels**

Pulse	Level	Pulses	Characteristics	Test time
3a	II	5	see ISO 7637-2 [14]	5 min.
3b	II	5	see ISO 7637-2 [14]	5 min.
4	II	5	Vs= -10V Va= -5V t6=25ms, t8=5s, tf=5ms	5 min.

Where the manufacturer does not require a direct connection to the 24 V main vehicle battery, the pulses in table 55 apply, in addition to the pulses in table 54.



Table 55: Additional levels: 24 V dc power port

Pulse	Level	Pulses	Characteristics	Test time
1a	II	10	t1=2,5s Ri=25Ω	
1b	II	10	t1=2,5s, Ri=100Ω	
2	II	10	t1=2,5s	

Where the tests for pulses 1a, 1b and 2 are not performed because the manufacturer declares that the equipment requires a direct connection to the vehicle battery, this fact shall be properly documented.

## History

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