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Radio Equipment and Systems (RES); ElectoMagnetic Compatibility (EMC) standard for Private land Mobile Radio (PMR) and ancillary equipment (speech and/or non-speech)

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Contents

Foreword

This (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

Other ETSs cover radiocommunications equipment not listed in the scope.

This ETS is based upon Generic Standards EN 50081-1 [1] and EN 50082-1 [2] and other standards where appropriate.

Transposition dates	
Date of adoption of this ETS:	22 December 1995
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1 Scope

This ETS covers the assessment of radiocommunications and ancillary equipment in respect of ElectroMagnetic Compatibility (EMC). Technical specifications related to the antenna port and emissions for the enclosure port of radio equipment are found in the related product standards for the effective use of the radio spectrum.

This ETS specifies the applicable EMC tests, the test methods, the limits and the minimum performance criteria for Private land Mobile Radio (PMR) equipment (speech and/or non-speech) operating in the frequency range 30 - 1000 MHz, and the associated ancillary equipment.

The environmental classification used in this ETS refers to the environment classification used in the Generic Standards EN 50081-1 [1], EN 50082-1 [2], except for the vehicular environment class which refers to ISO 7637 [11].

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 do not cover extreme cases which may occur in any location but have 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 observations regarding apparatus becoming dangerous or unsafe as a result of the application of the tests of this ETS, should be recorded in the test report.

2 Normative references

This ETS incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and relate to the publications 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 (1992): "Electromagnetic compatibility - generic emission standard. Part 1: Residential, commercial and light industry".

[2] EN 50082-1 (1992): "Electromagnetic compatibility - generic immunity standard. Part 1: Residential, commercial and light industry".

[3] EN 55022 (1994): "Limits and methods of measurement of radio interference characteristics of information technology equipment".

[4] CISPR Publication No. 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods".

[5] ENV 50140: "Basic immunity standard - Radiated, radio frequency, electromagnetic fields".

[6] IEC 801-2 (second edition 1991); Part 2: "Electrostatic discharge requirement".

[7] IEC 801-4 (1988); Part 4: "Electrical fast transients / burst requirements".

[8] ENV 50141: "Basic immunity standard - Conducted disturbances induced by radio-frequency fields".

[9] IEC 1000-4-11: "Voltage dips, short interruptions and voltage variations. Immunity tests".

[10] IEC 1000-4-5: "Surge immunity requirements".

[11] ISO 7637 (1990): "Road vehicles-Electrical disturbance by conducting and coupling; Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage"; and "Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".

3 Definitions

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

radiocommunications equipment: An apparatus which includes one or more transmitters and/or receivers and/or parts thereof.

This type of equipment (apparatus) is used in a fixed, mobile or a portable application.

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

- the equipment is intended for use in conjunction with a receiver, transmitter or transceiver to provide additional operational and/or control features to the radio equipment (e.g. to extend control to another position or location); and

- 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 basic functions.

port: A particular interface of the specified equipment (apparatus) with the external electromagnetic environment.

enclosure port: The physical boundary of the apparatus onto which an electromagnetic field may radiate or impinge.

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

4 General test conditions

This clause defines the general test configuration and is relevant for clauses 8 and 9.

4.1 Test conditions and configurations

The equipment shall be tested under conditions which are within the manufacturer's declared range of humidity, temperature and supply voltage.

The test configuration shall be as close to normal intended use as possible.

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.

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 actual operation conditions and to ensure that all the 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 configuration and mode of operation shall be recorded in the test report.

4.1.1 Emission tests

This subclause defines the test conditions and configurations for the emission tests as follows:

- the measurement shall be made in the operation mode producing the largest emission in the frequency band being investigated consistent with normal applications;

- an attempt shall be made to maximise the detected radiated emission for example by moving the cables of the equipment.

4.1.2 Immunity tests

This subclause defines the test conditions and configurations for the immunity tests as follows:

- the measurement shall be made in the mode of operation as required in subclause 4.1.2.1;

- for the immunity tests of ancillary equipment without 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.

4.1.2.1 Mode of operation

For the immunity tests of transmitters, the transmitter shall be operated at its maximum rated output power, modulated with normal test modulation (subclauses 4.1.2.2 and 4.1.2.3). A communication link shall be established (subclause 4.1.2.4) at the start of the test and maintained during the test.

For the immunity tests of receivers, the wanted input signal, coupled to the receiver, shall be modulated with normal test modulation (subclauses 4.1.2.2 and 4.1.2.5). A communication link shall be established (subclause 4.1.2.6) at the start of the test and maintained during the test.

For the immunity tests of duplex transceivers, the EUT may be configured in the repeater mode, consistent with the conditions given above.

4.1.2.2 Normal test modulation

For analogue speech equipment:

- the receiver wanted input signal shall be set to the nominal frequency of the receiver modulated with a sinusoidal audio frequency of 1 000 Hz to a deviation of 60 % peak system deviation for angle modulated equipment;

- the transmitter of the EUT shall be modulated with a sinusoidal audio frequency of 1 000 Hz at a deviation of 60 % peak system deviation for angle modulated equipment.

For digital speech equipment:

- the receiver wanted input signal shall be set to the nominal frequency of the receiver modulated with a test signal specified by the manufacturer which represents normal operation;

- the transmitter shall be modulated with a test signal which represents normal operation as specified by the manufacturer;

- the manufacturer may have to supply the test modulation/de-modulation equipment.

For non-speech equipment (data, specific response, etc.):

- the receiver wanted input signal shall be set to the nominal frequency of the receiver modulated with a test signal specified by the manufacturer which represents normal operation;

- the transmitter shall be modulated with a test signal which represents normal operation as specified by the manufacturer;

- the manufacturer may have to supply the test modulation/de-modulation equipment.

The test signal generator (modulation) shall be able to produce a continuous stream of data or a repetitive message.

The test signal receiver (de-modulator) shall be able to produce a readout of Bit Error Ratio (BER) of a continuous data stream or a repetitive readout of message acceptance.

4.1.2.3 Arrangements for test signals at the input of the transmitter

The transmitter should be modulated with normal test modulation, by an internal or external signal source capable of delivering the normal test modulation.

4.1.2.4 Arrangements for test signals at the output of the transmitter

For equipment without an antenna connector, the wanted signal to establish a communication link shall be delivered from the equipment to an antenna located within the test environment. The measuring equipment for the wanted signal shall be located outside of the test environment. Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment

For equipment with an antenna connector, the wanted signal to establish a communication link shall be delivered from the antenna connector by a coaxial cable. The measuring equipment for the wanted signal shall be located outside of the test environment. Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment.

4.1.2.5 Arrangements for test signals at the input of the receiver

For equipment without an antenna connector, the wanted input signal to establish a communication link shall be presented to the equipment from an antenna located within the test environment. It shall be approximately 40 dB above the minimum level necessary to achieve the performance criteria, measured while the power amplifiers generating the EMC disturbance are switched on but without excitation. This level of the wanted input signal is expected to represent a normal operation signal level and should be sufficient to avoid the broad band noise from the power amplifiers generating the EMC disturbance from influencing the measurement. The source of the wanted input signal shall be located outside of the test environment.

For equipment with an antenna connector, the wanted input signal to establish a communication 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 approximately 40 dB above the minimum level necessary to achieve the performance criteria, measured while the power amplifiers generating the EMC disturbance are switched on but without excitation.

4.1.2.6 Arrangements for test signals at the output of the receiver

For speech equipment the audio frequency output of the equipment should be coupled via an electrically non-conductive acoustic tube to an audio distortion meter or other measuring equipment outside of the test environment. Where it is not practical to use an electrically non-conductive acoustic tube, then other means of connecting the receiver output to an audio distortion meter or other measuring equipment shall be provided and recorded in the test report. Precautions shall be taken to ensure that any effect on the test is minimised.

For non-speech equipment the output of the receiver shall be coupled via an electrically non-conductive means to the test equipment outside the test environment. If the equipment has an output connector or port providing the receiver output then this port shall be used via a cable, consistent with the standard cable used in normal operation, connected to the test equipment outside the test environment. The test equipment may be supplied by the manufacturer. Precautions shall be taken to ensure that any effect on the test is minimised.

4.1.2.7 Receiver and receivers of transceivers exclusion band

The exclusion band for receivers and receivers of transceivers is the frequency range determined by the switching range, as declared by the manufacturer, extended as follows:

- the lower frequency of the exclusion band is the lower frequency of the switching range, minus 5 % of the centre frequency of the switching range, or minus 10 MHz, whichever will result in the lowest frequency;

- the upper frequency of the exclusion band is the upper frequency of the switching range, plus 5 % of the centre frequency of the switching range, or plus 10 MHz, which ever will result in the highest frequency.

The switching range is the maximum frequency range over which the receiver can be operated without reprogramming or realignment.

4.1.2.8 Transmitter exclusion band

The exclusion band for transmitters extends ± 25 kHz from the nominal operating frequency of the transmitter.

4.1.2.9 Narrow band responses on receivers and receivers of transceivers

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 creates a degradation of the audio or data output, it is necessary to establish whether the degradation is due to a narrow band response or to a wide band phenomena. Therefore, the unwanted signal frequency is increased by an amount equal to twice the bandwidth of the receiver IF filter immediately preceding the demodulator, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation disappears, then the response is considered as a narrow band response. If the degradation remains, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and one half times the bandwidth previously referred to.

If the degradation remains, the phenomena is considered wide band and therefore an EMC problem and the equipment fails the test.

Narrow band responses shall be disregarded.

5 Performance assessment

5.1 General

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

- the primary functions of the radio equipment to be tested during and after the EMC testing;

- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;

- the type of modulation, the characteristics of the transmission used for testing (random bit stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;

- the ancillary equipment to be combined with the radio equipment for testing (where applicable);

- an exhaustive list of ports, with the maximum cable lengths allowed, classified as either power or signal/control. Power ports shall further be classified as ac or dc power;

- the bandwidth of the IF filter immediately preceeding the demodulator.

5.2 Equipment which can provide a communications link

The test arrangement and signals, given in clause 4, apply to radio equipment or a combination of a radio equipment and ancillary equipment which permits the establishment of a communications link.

5.3 Equipment which does not provide a communications link

If the equipment is of a specialised nature (see subclause 6.1) which does not permit a communications link to be established or in the case of ancillary equipment tested in isolation, not connected to radio equipment, the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test. The manufacturer shall provide the method of observing the degradation of performance of the equipment.

The performance assessment carried out, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

5.4 Ancillary equipment

At the manufacturers discretion an ancillary equipment may be:

- declared compliant separately (in isolation) from a receiver, transmitter or transceiver to all the applicable immunity and emission clauses of this ETS;

- declared compliant to another appropriate harmonised EMC standard;

- tested with it connected to a receiver, transmitter or transceiver in which case compliance shall be demonstrated to the appropriate clauses of this ETS.

5.5 Equipment classification

Portable equipment or combinations of equipment declared as capable of being powered by the battery in a vehicle shall additionally be considered as a vehicular mobile equipment.

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

6 Performance criteria

6.1 General

The equipment shall meet the minimum performance criteria as specified in subclauses 6.2, 6.3, 6.4 and 6.5.

The establishment of the communication link at the start of the test, its maintenance and the assessment of the recovered signal are used as the performance criteria for the evaluation of the essential functions of the equipment during and after the test.

A portable equipment powered by the battery in a vehicle shall fulfil the applicable requirements set out by this ETS for vehicular mobile equipment.

A portable or mobile equipment powered by ac mains shall fulfil the applicable requirements set out by this ETS for base station equipment, although the tests performed are only those applicable to the input/output arrangements of the equipment, the performance criteria remain the same as the original class for the equipment.

If an equipment is of a specialised nature and the performance criteria specified in the table are not appropriate the manufacturer shall declare a substituted specification for an acceptable performance level or performance degradation as required by this ETS. The performance specification shall be included in the test report and the product description and documentation.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in the following subclauses.

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

For speech equipment, the distortion of the audio signal shall be measured during each individual exposure in the test sequence and shall not exceed 25 % measured in a post detection bandwidth determined by a first order band pass filter with a 3 dB bandwidth of 300 Hz - 3 kHz, without the use of psophometrical weighting filter.

For non-speech equipment four messages out of five or 90 % of the transmitted symbols shall be received correctly.

At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained during the test.

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

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

At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link.

At the conclusion of the total test comprising the series of individual exposures the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained during the test.

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

6.4 Performance criteria for Continuous phenomena applied to Receivers (CR)

For speech equipment, the distortion of the audio signal shall be measured during each individual exposure in the test sequence and shall not exceed 25 % measured in a post detection bandwidth determined by a first order band pass filter with a 3 dB bandwidth of 300 Hz - 3 kHz, without the use of psophometrical weighting filter.

For non-speech equipment four messages out of five or 90 % of the transmitted symbols shall be received correctly.

At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained during the test.

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

6.5 Performance criteria for Transient phenomena applied to Receivers (TR)

At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link.

At the conclusion of the total test comprising the series of individual exposures the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained during the test.

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

7 Applicability overview tables

7.1 Emission

Table 1

Application	Equipment test requirement			Reference subclause in this ETS	Reference document
	Base station and ancillary for fixed use	Mobile and ancillary for vehicular use	Portable and ancillary for portable use		
Enclosure , ancillary	applicable	applicable	applicable	8.1	EN 55022 [3]
DC power input/output port	applicable	applicable	not applicable	8.2	EN 55022 [3] CISPR 16 [4]
AC mains power input/output port	applicable	not applicable	not applicable	8.3	EN 55022 [3]

7.2 Immunity

Table 2

Phenomena	Application	Equipment test requirement			Reference subclause in this ETS	Reference document
		Base station and ancillary for fixed use	Mobile and ancillary for vehicular use	Portable and ancillary for portable use		
RF electro-magnetic field 80-1000 MHz	Enclosure, radio equipment with or without ancillary connected	applicable	applicable	applicable	9.1	ENV 50140 [5]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.2	IEC 801-2 [6]
Fast transient common mode	Signal & control ports, dc & ac power input ports	applicable	not applicable	not applicable	9.3	IEC 801-4 [7]
RF common mode 0,15-80 MHz	Signal & control ports, dc & ac power input ports	applicable	applicable	not applicable	9.4	ENV 50141 [8]
Transients and surges	DC power input ports	not applicable	applicable	not applicable	9.5	ISO 7637 Parts 1&2 [11]
Voltage dips and interruptions	AC mains power input ports	applicable	not applicable	not applicable	9.6	IEC 1000-4-11 [9]
Surges common and differential mode	AC mains power input ports	applicable	not applicable	not applicable	9.7	IEC 1000-4-5 [10]

8 Test methods and limits for emission tests

8.1 Enclosure of ancillary equipment

This test is applicable to the enclosure of ancillary equipment i.e. not connected to the radio equipment.

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

8.1.1 Definition

This test assesses the ability of ancillary equipment to limit unwanted emissions from the enclosure.

8.1.2 Test method

The test method shall be in accordance with EN 55022 [3].

8.1.3 Limits

The value of the limits from EN 55022 [3] (10 m measuring distance) shall be used for ancillary equipment tested in isolation.

Table 3: Limits for unwanted emissions for ancillary equipment tested in isolation

Frequency range	Limit (quasi-peak)
30 - 230 MHz	30 dBµV/m
> 230 - 1 000 MHz	37 dBµV/m

8.2 DC power input/output port

This test is applicable to equipment which may have dc cables longer than 3 metres.

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.

8.2.1 Definition

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

8.2.2 Test method

For equipment with a current consumption below 16 A the test method shall be in accordance with EN 55022 [3] 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 µH Line Impedance Stabilising Networks (LISNs), with 50 Ω measurement ports. The LISNs shall be in accordance with the requirements of Section two of CISPR Publication 16-1 [4].

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

The equipment shall be installed with a ground plane as defined in EN 55022 [3] subclause 9.3. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of section one of CISPR Publication 16-1 [4].

8.2.3 Limits

The equipment shall meet the limits below (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.2.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

The following limits shall apply:

Table 4: Limits for equipment not required to be connected to a local dedicated dc source

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

Table 5: Limits for equipment required to be connected to a local dedicated dc source i.e. not an extensive dc network

Frequency range	Quasi-peak	Average
> 0,15 - 0,5 MHz	79 dBµV	66 dBµV
> 0,5 - 30 MHz	73 dBµV	60 dBµV

8.3 AC mains power input/output port

This test is applicable to equipment powered by the ac mains.

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.

8.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to limit internal noise from the ac mains power input/output ports.

8.3.2 Test method

The test method shall be in accordance with EN 55022 [3].

8.3.3 Limits

The value of the limits shall be according to EN 55022 [3].

Table 6: Limits for conducted spurious

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

9 Test methods and levels for immunity tests

9.1 Radio frequency electromagnetic field (80-1000 MHz)

This test is applicable for 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.

9.1.1 Definition

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

9.1.2 Test method

The test method shall be in accordance with ENV 50140 [5] except that the following requirements and evaluation of test results shall apply:

- the test level shall be 3 V/m unmodulated. The test signal shall then be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 400 Hz;

- for receivers and transmitters only, the stepped frequency increments shall be 1 % of the momentary frequency;

- for transmitters in transceivers with a non-continuous duty cycle the stepped frequency increments may be 10 % of the momentary frequency;

- the test shall be performed over the frequency range 80 - 1000 MHz with the exception of an exclusion band for transmitters, (subclause 4.1.2.8), and for receivers and duplex transceivers, (subclause 4.1.2.7);

- the test shall be carried out on one surface. The surface selected to face the source of the interference signal shall be the one anticipated by the test house to be the most susceptible;

- responses on receivers and duplex transceivers occurring at discrete frequencies which are narrow band responses, are disregarded from the test (see subclause 4.1.2.9);

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

9.1.3 Performance criteria

For transmitters the performance criteria CT (subclause 6.2) shall apply.

For receivers and duplex transceivers the performance criteria CR (subclause 6.4) shall apply.

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

9.2 Electrostatic discharge

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

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

9.2.1 Definition

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

9.2.2 Test method

The test method shall be in accordance with IEC 801-2 [6].

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

- for contact discharge, the equipment shall be tested at ± 2 kV and ± 4 kV; for air discharge, the equipment shall be tested at ± 2 kV, ± 4 kV and ± 8 kV (see IEC 801-2 clause 5 [6]);

- electrostatic discharges shall be applied to all exposed surfaces of the equipment except where the user documentation specifically indicates a requirement for appropriate protective measures. (IEC 801-2 subclause 8.3.1 [6]).

9.2.3 Performance criteria

For transmitters the performance criteria TT (subclause 6.3) shall apply.

For receivers and duplex transceivers the performance criteria TR (subclause 6.5) shall apply.

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

9.3 Fast transients common mode

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

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

This test shall be performed on signal ports, control ports and dc power input ports when the manufacturer declares that the cables may be longer than 3 m.

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

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

9.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of fast transients on one of the input/output ports.

9.3.2 Test method

For transmitters, receivers, transceivers and ancillary equipment, which may have longer cables than 3 m, as declared by the manufacturer, or are connected to the ac mains, the test method shall be in accordance with IEC 801-4 [7] except that the following requirements and evaluation of test results shall apply:

- the test level for signal and control ports shall be 0,5 kV open circuit voltage as given in clause 5 of IEC 801-4 [7];

- the test level for dc power input ports shall be 0,5 kV open circuit voltage as given in clause 5 of IEC 801-4 [7];

- the test level for ac mains power input ports shall be 1 kV open circuit voltage as given in the table in clause 5 of IEC 801-4 [7].

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

9.3.3 Performance criteria

For transmitters the performance criteria TT (subclause 6.3) shall apply.

For receivers and duplex transceivers the performance criteria TR (subclause 6.5) shall apply.

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

9.4 RF common mode, 0,15 MHz - 80 MHz (current clamp injection)

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

This test shall be performed on signal, control, and dc power input ports of mobile and ancillary equipment, where the manufacturer declares that the cables may be longer than 2 m.

This test shall be performed on signal, control, dc power and ac mains power input ports of base station and fixed ancillary equipment, where the manufacturer declares that the cables may be longer than 1 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 2 m or 1 m (see above), a list of ports which were not tested for this reason shall be included in the test report.

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

9.4.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance.

9.4.2 Test method

The test method shall be the current clamp injection method in accordance with ENV 50141 [8], except that the following requirements and evaluation of test results shall apply:

- the test level shall be severity level 2 as given in ENV 50141 [8] corresponding to 3 V RMS unmodulated. The test signal shall then be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 400 Hz;

- the test shall be performed over the frequency range 150 kHz - 80 MHz with the exception of an exclusion band for transmitters, (see subclause 4.1.2.8), and for receivers and duplex transceivers, (see subclause 4.1.2.7);

- for receivers and transmitters only the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz - 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz - 80 MHz;

- for transmitters in transceivers with a non-continuous duty cycle the stepped frequency increments may be 500 kHz in the frequency range 150 kHz - 5 MHz and 10 % frequency increment of the momentary frequency in the frequency range 5 MHz - 80 MHz;

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

- responses on receivers and duplex transceivers occurring at discrete frequencies which are narrow band responses, are disregarded from the test, (subclause 4.1.2.9);

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

9.4.3 Performance criteria

For transmitters the performance criteria CT (subclause 6.2) shall apply.

For receivers and duplex transceivers the performance criteria CR (subclause 6.4) shall apply.

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

9.5 Transients and surges, vehicular environment

These tests are applicable for 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 configuration of the combination of radio and ancillary equipment.

9.5.1 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.

9.5.2 Test method

The test method shall be in accordance with ISO 7637; Part 1 [11] applicable for 12 V dc operated equipment and ISO 7637 Part 2 [11] applicable for 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 9.5.2.2;

- 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 subclauses 9.5.2.1 and 9.5.2.2.

9.5.2.1 Requirements for 12 V dc powered equipment

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

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

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

  - Vs = 5 V; Va = 2,5 V; t6 = 25 ms; t8 = 5 s; tf = 5 ms.

Where the manufacturer does not require a direct connection to the 12 V main vehicle battery, the following pulses apply, in addition to the pulses 3a, 3b and 4:

- pulse 1, level II: t1 = 2,5 s; 10 pulses;

- pulse 2, level II: t1 = 2,5 s; 10 pulses;

- pulse 7, level II: 5 pulses.

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 recorded in the test report.

9.5.2.2 Requirements for 24 V dc powered equipment

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

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

- pulse 4, level II, 5 pulses, the test shall be carried out in accordance with ISO 7637; Part 1 [11] but with the following characteristics:

  - Vs = 10 V; Va = 5.0 V; t6 = 25 ms; t8 = 5 s; tf = 5 ms.

Where the manufacturer does not require a direct connection to the 24 V main vehicle battery, the following pulses apply, in addition to the pulses 3a, 3b and 4:

- pulse 1a, level II: t1 = 2,5 s; Ri - 25 Ω; 10 pulses;

- pulse 1b, level II: t1 = 2,5 s; Ri - 100 Ω; 10 pulses;

- pulse 2, level II: t1 = 2,5 s; 10 pulses.

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 recorded in the test report.

9.5.3 Performance criteria

For transmitters, pulses 3a and 3b, the performance criteria CT (subclause 6.2) shall apply. For pulses 1, 1a, 1b, 2, 4 and 7 the performance criteria TT (subclause 6.3) shall apply, with the exception that the link need not be maintained during exposure and may have to be re-established.

For receivers and duplex transceivers pulses 3a and 3b the performance criteria CR (subclause 6.4) shall apply. For pulses 1, 1a, 1b, 2, 4 and 7 the performance criteria TR (subclause 6.5) shall apply, with the exception that the link need not be maintained during exposure and may have to be re-established.

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

9.6 Voltage dips and interruptions

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

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

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

9.6.1 Definition

These tests assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of voltage dips and interruptions on the ac mains power input ports.

9.6.2 Test method

The test method shall be in accordance with IEC 1000-4-11 [9] except that the following requirements and evaluation of test results shall apply.

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms; and

- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms; and

- a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 s.

9.6.3 Performance criteria

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

- for transmitters the performance criteria CT (subclause 6.2);

- for stand alone receivers or receivers which are part of simplex or duplex transceivers the performance criteria CR (subclause 6.4);

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

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms the following performance criteria apply:

- for transmitters the performance criteria TT (subclause 6.3);

- for stand alone receivers or receivers which are part of simplex or duplex transceivers the performance criteria TR (subclause 6.5);

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

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms and/or a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 s the following performance criteria apply:

- in the case where the equipment is fitted with or connected to a battery back-up the performance criteria TT (subclause 6.3) or TR (subclause 6.5) apply as appropriate;

- in the case where the is powered solely from the ac mains supply (without the use of a parallel battery back-up) the communications link need not be maintained and may have to be re-established and volatile user data may have been lost.

In the event of loss of the communications link or in the event of loss of user data, this fact shall be recorded in the test report, the product description and the user documentation.

9.7 Surges common and differential mode

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

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

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

9.7.1 Definition

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

9.7.2 Test method

The test method shall be in accordance with IEC 1000-4-5 [10] except that the following requirements and evaluation of test results shall apply:

- the test level shall be 1 kV open circuit voltage for common mode and 0,5 kV open circuit voltage for differential mode;

- the surges shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground, (true common mode), the series resistance shall be 10 Ω.

9.7.3 Performance criteria

For transmitters the performance criteria TT (subclause 6.3) shall apply.

For receivers and duplex transceivers the performance criteria TR (subclause 6.5) shall apply.

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

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