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**Radio Equipment and Systems (RES);
Electro-Magnetic Compatibility (EMC) for
European Radio Message System (ERMES) paging receivers**

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE

Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

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Contents

Foreword	5
1 Scope	7
2 Normative references	7
3 Definitions	8
4 General test conditions	8
4.1 Test conditions	8
4.2 Normal test modulation	9
4.3 Arrangements for test signals at the input of the receiver	9
4.4 Arrangements for test signals at the output of the receiver	9
4.5 Narrow band responses of ERMES receivers	9
5 Performance assessment	10
5.1 General	10
5.2 Equipment which can provide a communications link	10
5.3 Equipment which does not provide a communications link	10
5.4 Equipment classification	10
5.5 Ancillary equipment	11
6 Performance criteria	11
6.1 Performance criteria for Continuous phenomena applied to Receivers (CR)	11
6.2 Performance criteria for Transient phenomena applied to Receivers (TR)	12
7 Applicability overview tables	12
7.1 Emission	12
7.2 Immunity	13
8 Test methods and limits for emission tests of receivers and/or ancillary equipment	13
8.1 Test configuration	13
8.2 Enclosure - ancillary equipment	14
8.2.1 Definition	14
8.2.2 Test method	14
8.2.3 Limits	14
8.3 DC power input/output port	14
8.3.1 Definition	14
8.3.2 Test method	14
8.3.3 Limit for conducted RF signals	15
8.4 AC mains power input/output ports	15
8.4.1 Definition	15
8.4.2 Test method	15
8.4.3 Limit	15
9 Test methods and levels for immunity tests of ERMES receivers and/or ancillary equipment	15
9.1 Test configuration	15
9.2 RF electromagnetic field (80 - 1 000 MHz)	16
9.2.1 Definition	16
9.2.2 Test method and level	16
9.2.3 Performance criteria	16
9.3 Electrostatic discharge	16
9.3.1 Definition	17
9.3.2 Test method and levels	17
9.3.3 Performance criteria	17
9.4 Fast transients common mode	17

	9.4.1	Definition.....	17
	9.4.2	Test method and levels.....	17
	9.4.3	Performance criteria	18
9.5		RF common mode 0,15 MHz - 80 MHz (current clamp injection)	18
	9.5.1	Definition.....	18
	9.5.2	Test method and level	18
	9.5.3	Performance criteria	19
9.6		Transients and surges, vehicular environment	19
	9.6.1	Definition.....	19
	9.6.2	Test method and level	19
	9.6.3	Performance criteria	20
9.7		Voltage dips and interruptions.....	20
	9.7.1	Definition.....	20
	9.7.2	Test method and levels.....	20
	9.7.3	Performance criteria	20
9.8		Surges, common and differential mode	21
	9.8.1	Definition.....	21
	9.8.2	Test method and levels.....	21
	9.8.3	Performance criteria	21
		History	22

Foreword

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

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

This ETS is based upon the Generic Standards EN 50081-1 [1] and EN 50082-1 [2], ETS 300 339 [3], and other standards where appropriate, to meet the essential requirements of the Council Directive 89/336/EEC [4].

Every ETS prepared by ETSI is a voluntary standard. This ETS contains text which may be used for regulatory purposes. This text does not make this ETS mandatory in its status as a standard. However, the ETS can be referenced, wholly or in part, for mandatory application by decisions of regulatory bodies.

Transposition dates	
Date of latest announcement of this ETS (doa):	28 February 1995
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1 Scope

This ETS covers the requirements for the assessment of ERMES paging receivers and ancillary equipment in respect of Electro-Magnetic Compatibility (EMC) and may be used to demonstrate presumption of compliance with the protection requirements of Council Directive 89/336/EEC [4], Article 4 (EMC Directive).

This ETS specifies the applicable EMC tests, the method of measurements, the limits and the minimum performance criteria for ERMES paging receivers (as defined in ETS 300 133 [5]) and the associated ancillary equipment.

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 the ISO 7637 [6].

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 requirement 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 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 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] Draft prETS 300 339: "Radio Equipment and Systems (RES) - General Electro-Magnetic Compatibility (EMC) for radio equipment".
- [4] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".
- [5] ETS 300 133 Parts 1 to 7: "Paging Systems (PS) - European Radio Message System (ERMES)".
- [6] 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".

ISO 7637 (1990): "Road vehicles-Electrical disturbance by conducting and coupling" Part 2: "Commercial vehicles with nominal 24 V supply voltage-Electrical transient conduction along supply lines only".

- [7] EN 55022 (1987): "Limits and methods of measurement of radio interference characteristics of information technology equipment".
- [8] CISPR Publication No. 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods".
- [9] ENV 50140: "Basic immunity standard - Radiated, radio frequency, electromagnetic fields".
- [10] IEC 801-2 (second edition 1991) Part 2: "Electrostatic discharge requirements".
- [11] IEC 801-4 (1988) Part 4: "Electrical fast transients / burst requirements".
- [12] ENV 50141: "Basic immunity standard - Conducted disturbances induced by radio-frequency fields".
- [13] IEC 1000-4-11: "Voltage dips, short interruptions and voltage variations. Immunity tests".
- [14] IEC 1000-4-5: "Surge immunity requirements".

3 Definitions

For the purposes of this ETS the following definitions apply:

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

- the equipment is intended for use in conjunction with a paging receiver, to provide additional operational and/or control features to the paging receiver (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 paging receiver; and
- the paging receiver to which it is connected, is capable of providing some intended operation such as receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

ERMES paging receiver: A receiver which operates in the ERMES paging system.

manufacturer: The legal entity responsible under the terms of the Council Directive 89/336/EEC [4] for placing the product on the market.

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

4 General test conditions

4.1 Test conditions

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

The test conditions shall be recorded in the test report.

The test configuration shall be as close to normal intended use as possible and shall be recorded in the test report.

Whenever an ERMES paging receiver is provided with a detachable antenna, the EUT shall be tested with the antenna fitted in a manner typical of normal intended use.

For the immunity tests of receivers, the wanted input signal (when called for), applied to the receiver, shall be modulated with normal test modulation, see subclauses 4.2 and 4.3. For all the immunity tests according to this ETS, except for the spot frequency test of the radio frequency immunity test, see subclause 9.1, a communication link shall be established and the memory shall be loaded with recognisable messages, see subclause 4.4.

For the spot frequency test of the radio frequency immunity test, see subclause 9.1, a communication link shall be established and repetitive calls shall be transmitted to the Equipment Under Test (EUT).

4.2 Normal test modulation

The wanted input signal shall be set to the nominal frequency selected for the EUT and modulated with normal test modulation, coded according to the ERMES standard ETS 300 133-4 [5], enabling to test that a communication link is established.

4.3 Arrangements for test signals at the input of the receiver

The manufacturer shall at the time of submission supply a test fixture and a message generator to generate the wanted input signal according to the ERMES standard, to check that the equipment is able to receive a call and store it in its memory before and after the test.

During the spot frequency test of radio frequency immunity, see subclause 9.1, the wanted signal, to establish a communication link and to check that the equipment is capable of receiving a call during the test, shall be presented to the equipment from an antenna located within the test environment. The level shall be approximately 60 dB above the level where the equipment just starts reacting on some of the calls transmitted. The signal generator providing the wanted input signal shall be located outside of the test environment.

4.4 Arrangements for test signals at the output of the receiver

From the performance check before and after the test it shall be possible to assess the performance of the equipment from the presented messages and/or from the call received alert signals of the equipment.

During the spot frequency test of radio frequency immunity, see subclause 9.1, the call received alert signal output of the equipment shall be coupled to the outside of the test environment via non-metallic means and it shall be possible to assess the performance of the equipment from this signal.

Adequate measures shall be taken to protect the measuring equipment from the effect of all interferences, e.g. radiated fields and conducted interferences.

4.5 Narrow band responses of ERMES receivers

Responses on ERMES receivers occurring during the test at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method.

If during the test the unwanted signal creates a degradation of the call received alert signal acceptance ratio below 4:5 (four out of five), it is necessary to establish whether the distortion 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 nominal bandwidth of the receiver pre-demodulation 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 disappears, then the response is considered as a narrow band response.

If the degradation 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 procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted to two and one half times the bandwidth previously referred to. If the degradation still does not disappear, the phenomena is considered wide band and therefore an EMC problem and the equipment fails the test.

Narrow band responses are disregarded.

5 Performance assessment

5.1 General

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

- the primary functions of the ERMES paging equipment to be tested 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 paging receiver for testing;
- the ancillary equipment submitted for test on a stand alone basis, not combined with the paging receiver for testing;
- the user control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;
- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as ac or dc power;
- the bandwidth of the IF filter immediately preceding the demodulator.

5.2 Equipment which can provide a communications link

If a function of the paging receiver, or combination of a paging receiver and ancillary equipment, permits the establishment of a communications link, the test modulation, test arrangement etc. as required in clause 4 apply.

The performance during the spot frequency test of the radio frequency immunity test, see subclause 9.2, shall be established by assessment of the call received alert signal.

5.3 Equipment which does not provide a communications link

If a function of the paging receiver does not permit a communications link to be established or in the case of ancillary equipment tested on a stand alone basis, see clause 6, 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 following:

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

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

5.4 Equipment classification

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

ERMES paging equipment or combinations of equipment declared as capable of being powered for intended use by ac mains shall additionally be considered as a base station receiver.

5.5 Ancillary equipment

At the manufacturers discretion an ancillary equipment may be:

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

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

6 Performance criteria

The equipment shall meet the minimum performance criteria as specified in subclauses 6.1 and 6.2.

For all the immunity tests according to this ETS, except the spot frequency test of radio frequency immunity, see subclause 9.2:

- the establishment of the communication link and loading of the memory with recognisable messages at the start of the test;
- the maintenance of the memory and no false calling during the test;
- the assessment of the memory (messages);
- the ability to receive and load the memory at the conclusion of the test;

are used as the performance criteria to ensure that the primary functions of the ERMES paging receiver are evaluated.

For the spot frequency test of the radio frequency immunity test, see subclause 9.2:

- the establishment of the communication link;
- the call received alert signal and no false calling during the test;

are used as the performance criteria to ensure that the primary functions of the ERMES paging receiver are evaluated.

If an equipment is of a specialised nature, such that the performance criteria described in subclauses 6.1 and 6.2 are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance, or degradation of performance, during and/or after testing, as required by this ETS. The specification of the performance criteria 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 called for in the following clauses.

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

During the test no false calling shall occur.

At the conclusion of the total test the EUT shall operate as intended with no loss of user control functions or stored data (messages), as declared by the manufacturer.

During the spot frequency test of radio frequency immunity, see subclause 9.2, the EUT shall provide a call received alert signal acceptance ratio of 4:5 (four out of five) or better.

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

During the test no false calling shall occur.

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 (messages), as declared by the manufacturer.

7 Applicability overview tables

7.1 Emission

Table 1: Emission applicability

Application	Equipment test requirement			Reference clause in this ETS	Reference document
	Base station receiver and ancillary equipment for fixed use	Mobile and ancillary equipment for vehicular use	Portable and ancillary equipment for portable use		
Enclosure	applicable for ancillary equipment not integrated into receivers.	applicable for ancillary equipment not integrated into receivers.	applicable for ancillary equipment not integrated into receivers.	8.2	EN 55022 [7]
DC power in/out	applicable	applicable	not applicable	8.3	EN 55022 [7], CISPR 16-1 [8]
AC mains	applicable	not applicable	not applicable	8.4	EN 55022 [7]

7.2 Immunity

Table 2: Immunity applicability

Phenomena	Application	Equipment test requirement			Reference clause in this ETS	Reference document
		Base station receiver and ancillary equipment for fixed use	Mobile and ancillary equipment for vehicular use	Portable and ancillary equipment for portable use		
RF electro-magnetic field (80 - 1 000 MHz)	Enclosure	applicable	applicable	applicable	9.2	ENV 50140 [9]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.3	IEC 801-2 [10]
Fast transients common mode	Signal and control ports, dc and ac power input ports	applicable	not applicable	not applicable	9.4	IEC 801-4 [11]
RF common mode 0,15 - 80 MHz (current clamp injection)	Signal and control ports, dc and ac power ports	applicable	applicable	not applicable	9.5	ENV 50141 [12]
Transients and surges, vehicular environment	DC power input ports	not applicable	applicable	not applicable	9.6	ISO 7637 Parts 1 and 2 [6]
Voltage dips and interruptions	AC mains power input ports	applicable	not applicable	not applicable	9.7	IEC 1000-4-11 [13]
Surges, common and differential mode	AC mains power input ports	applicable	not applicable	not applicable	9.8	IEC 1000-4-5 [14]

8 Test methods and limits for emission tests of receivers and/or ancillary equipment

8.1 Test configuration

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

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- the equipment shall be configured in a manner which is representative of a normal/typical operation, where practical;
- an attempt shall be made to maximise the detected radiated emission, e.g. by moving the cables of the equipment;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;

- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are tested;
- 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.

8.2 Enclosure - ancillary equipment

This test is applicable to ancillary equipment not integrated into a receiver.

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

8.2.1 Definition

This test assesses the ability of ancillary equipment to limit any spurious radiation from the enclosure.

8.2.2 Test method

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

8.2.3 Limits

Class B limits shall be according to EN 55022 [7] shown in table 3 (10 m measuring distance).

Table 3: Limits for spurious radiation (Class B)

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

8.3 DC power input/output port

This test is applicable for base station receivers, mobile and ancillary equipment which may have dc cables longer than three (3) m.

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

8.3.1 Definition

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

8.3.2 Test method

The dc power ports shall be connected to a dc power source via a Line Impedance Stabilisation Network (LISN) in accordance with EN 55022 [7].

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 [7], subclause 9.3. The reference earth point of the LISN 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 CISPR Publication No. 16-1 [8].

8.3.3 Limit for conducted RF signals

The equipment shall meet the limits in table 4, including the average limit and the quasi-peak limit, when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.3.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

Table 4: Limits for conducted RF signals

Frequency range	Quasi-peak	Average
0,15 - 0,5 MHz	66 - 56 dB μ V	56 - 46 dB μ V
> 0,5 - 5 MHz	56 dB μ V	46 dB μ V
> 5 - 30 MHz	60 dB μ V	50 dB μ V

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

8.4 AC mains power input/output ports

This test is applicable for base station receivers and fixed ancillary equipment powered by the ac mains.

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

8.4.1 Definition

This test assesses the ability of ERMES receivers and ancillary equipment to limit its internal noise from being present on the ac mains power input/output ports.

8.4.2 Test method

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

8.4.3 Limit

The limits shall be Class B according to EN 55022 [7] shown in table 5.

Table 5: Limits for conducted RF signals (Class B)

Frequency range	Quasi-peak	Average
0,15 - 0,5 MHz	66 - 56 dB μ V	56 - 46 dB μ V
> 0,5 - 5 MHz	56 dB μ V	46 dB μ V
> 5 - 30 MHz	60 dB μ V	50 dB μ V

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

9 Test methods and levels for immunity tests of ERMES receivers and/or ancillary equipment

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 coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- if 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.

9.2 RF electromagnetic field (80 - 1 000 MHz)

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

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

9.2.1 Definition

This test assesses the ability of ERMES paging receivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic field disturbance.

9.2.2 Test method and level

The test method shall be in accordance with ENV 50140 [9] except that the following requirements shall apply:

- the test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- the stepped frequency increments shall be 1 % of the momentary frequency;
- the spot frequency test shall be performed on the frequencies 80, 104, 136, 200, 260, 330, 430, 560, 715 and 920 MHz \pm 1 MHz;
- the test shall be performed over the frequency range 80 - 1 000 MHz, with the exception of the ERMES frequency band extended by 25 kHz in both directions;
- narrow band responses shall be disregarded, see subclause 4.5.

9.2.3 Performance criteria

For ERMES receivers the performance criteria CR shall apply, see subclause 6.1.

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

9.3 Electrostatic discharge

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

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

9.3.1 Definition

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

9.3.2 Test method and levels

The test method shall be in accordance with IEC 801-2 [10].

For ERMES receivers and ancillary equipment the following requirements shall apply:

- for contact discharge, the equipment shall pass at ± 2 kV and ± 4 kV; for air discharge shall pass at ± 2 kV, ± 4 kV and ± 8 kV, see IEC 801-2 [10], clause 5;
- electrostatic discharges shall be applied to all exposed surfaces of the EUT except where the user documentation specifically indicates a requirement for appropriate protective measures, see IEC 801-2 [10], subclause 8.3.1.

9.3.3 Performance criteria

For ERMES receivers the performance criteria TR shall apply, see subclause 6.2.

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

9.4 Fast transients common mode

This test is applicable for base station receivers and fixed 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/output ports if the cables may be longer than three (3) m.

Where this test is not carried out on any ports because the manufacturer declares that it is not intended to be used with cables longer than three (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 equipment or a representative configuration of the combination of radio and ancillary equipment.

9.4.1 Definition

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

9.4.2 Test method and levels

The test method shall be in accordance with IEC 801-4 [11] except that the following requirements shall apply.

For ERMES receivers and ancillary equipment, which have cables longer than 3 m, or are connected to the ac mains:

- the test level for signal and control ports shall be severity level 2 corresponding to 0,5 kV open circuit voltage as given in clause 5 of IEC 801-4 [11];

- the test level for dc power input/output ports shall be severity level 2 corresponding to 1 kV open circuit voltage as given in clause 5 of IEC 801-4 [11];
- the test level for ac mains power input ports shall be severity level 3 corresponding to 2 kV open circuit voltage as given in the table clause 5 of IEC 801-4 [11].

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

9.4.3 Performance criteria

ForERMES receivers the performance criteria TRshall apply, see subclause 6.2.

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

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

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

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

This test shall be performed on signal, control, dc power and ac mains power input/output ports of base station receivers and fixed ancillary equipment, which may have cables longer than one (1) metre.

Where this test is not carried out on any ports because the manufacturer declares that it is not intended to be used with cables longer than two (2) m (mobile and ancillary equipment) or one (1) metre (base station receivers and fixed ancillary), a list of ports which were not tested shall be included in the test report.

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

9.5.1 Definition

This test assesses the ability ofERMES paging receivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the input/output ports.

9.5.2 Test method and level

The test method shall be the current clamp injection method in accordance with ENV 50141 [12], except that the following requirements shall apply:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- 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;
- the test level shall be severity level 2 as given in ENV 50141 [12] corresponding to 3 V RMS, at a transfer impedance of 150 Ω .
- no intrusive or direct connection shall be made to any of the lines of any input/output port, consequential the current clamp injection method shall be used;
- narrow band responses shall be disregarded, see subclause 4.5;
- the test shall be performed over the frequency range 150 kHz - 80 MHz.

9.5.3 Performance criteria

For ERMES receivers the performance criteria CR shall apply, see subclause 6.1.

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

9.6 Transients and surges, vehicular environment

These tests are applicable to mobile and ancillary equipment intended for use in a vehicular environment.

These tests shall be performed on 12 volt and 24 volt dc power input ports of mobile and ancillary equipment, intended for vehicular use.

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

9.6.1 Definition

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

9.6.2 Test method and level

The test method shall be in accordance with ISO 7637 Part 1 [6] for 12 volt dc powered equipment and ISO 7637 Part 2 [6] for 24 volt dc powered equipment.

1) The following requirements shall apply for 12 volt dc powered equipment:

a) where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 12 volt main vehicle battery the following requirements in accordance with ISO 7637 [6] Part 1 shall apply:

- pulse 3a and 3b, level II, with the test time reduced to 5 min for each;
- pulse 4, level II, 5 pulses, with the characteristics as follows:

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

b) where the manufacturer does not require the EUT to have a direct connection to the 12 volt main vehicle battery, the following pulses apply, in addition to the pulses in 1) a):

- 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 manufacturer declares that the EUT requires a direct connection to the vehicle battery, and therefore the tests in accordance with 1) b) are not carried out, this shall be stated in the test report.

2) The following requirements shall apply for 24 volt dc powered equipment:

a) where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 24 volt main vehicle battery the following requirements in accordance with ISO 7637 [5] Part 2 shall apply:

- pulse 3a and 3b, level II, with the test time reduced to 5 min for each;
- pulse 4, level II, 5 pulses, with the characteristics as follows:

$$V_s - 10 \text{ V}, \quad V_a - 5,0 \text{ V}, \quad t_6 - 25 \text{ ms}, \quad t_8 - 5 \text{ s}, \quad t_f - 5 \text{ ms}.$$

The test for this pulse 4 shall be carried out as specified in ISO 7637 [6] Part 1.

b) where the manufacturer does not require the EUT to have a direct connection to the 24 volt main vehicle battery, the following pulses apply, in addition to the pulses in 2) a):

- | | | | | |
|---|--------------------|-------------|---------------------|------------|
| - | 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 manufacturer declares that the EUT requires a direct connection to the vehicle battery, and therefore the tests in accordance with 2) b) are not carried out, this shall be stated in the test report.

For radio and ancillary equipment designed to operate at both dc power voltages both requirement 1) and 2) shall apply.

For radio equipment designed to operate at 12 volt dc power supply, but operating from a 24 volt dc power adapter ancillary, then the radio equipment shall comply with the requirements in 1) and the configuration of the radio equipment and the power adapter shall comply with the requirements of 2).

9.6.3 Performance criteria

ForERMES receivers pulses 3a and 3b the performance criteria CR shall apply, see subclause 6.6. For pulses 1, 1a, 1b, 2, 4 and 7 the performance criteria TR shall apply, see subclause 6.7.

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

9.7 Voltage dips and interruptions

These tests are applicable for base station receivers and fixed ancillary equipment powered by the ac mains.

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

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

9.7.1 Definition

These tests assess the ability ofERMES paging receivers and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the ac mains power input ports.

9.7.2 Test method and levels

The following requirements shall apply.

The test method shall be in accordance with IEC 1000-4-11 [13].

The test levels shall be:

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

9.7.3 Performance criteria

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

- forERMES receivers the performance criteria CR, see subclause 6.1;

- for ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with ERMES receivers in which case the corresponding performance criteria CR shall apply, see subclause 6.1.

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

- for ERMES receivers the performance criteria TR, see subclause 6.2;
- for ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with ERMES receivers in which case the corresponding performance criteria TR shall apply, see subclause 6.2.

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 5 000 ms the following performance criteria shall apply:

- in the case where the equipment is fitted with or connected to a battery back-up the performance criteria TR shall apply, see subclause 6.2;
- in the case where the equipment 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 communications or in the event of loss of user data, this fact shall be recorded in the test report, the product description and the user documentation.

9.8 Surges, common and differential mode

These tests are applicable for base station receivers 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 ERMES receiver equipment or a representative configuration of the combination of receiver and ancillary equipment.

9.8.1 Definition

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

9.8.2 Test method and levels

The following requirements shall apply.

The test method shall be in accordance with IEC 1000-4-5 [14].

The test level shall be severity level 2 corresponding to 1 kV open circuit voltage for line-to-ground and severity level 2 corresponding to 0,5 kV open circuit voltage for line to line;

The transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground, for line to ground tests, i.e. true common mode, with a series resistance of 10 Ω .

9.8.3 Performance criteria

For ERMES receivers the performance criteria TR shall apply, see subclause 6.2.

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

History

Document history	
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