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ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics and test methods for radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz

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Candidate Harmonized European Standard (Telecommunications series)

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Short Range Devices (SRD);
Technical characteristics and test methods for
radio equipment in the frequency range 9 kHz to 25 MHz and
inductive loop systems in the frequency range 9 kHz to 30 MHz**

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document together with ETS 300 683 [5], is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC [1] as amended).

The technical parameters which are relevant to the EMC Directive are listed in normative annex G.

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Introduction

The present document is drafted on the assumption that type test measurements, performed in an accredited test laboratory will be accepted by the various National Regulatory authorities in order to grant type approval, provided the National Regulatory requirements are met. This is in compliance with CEPT/ERC Recommendation T/R 01-06 [2].

Included are methods of measurement for equipment, such as inductive loop systems, fitted with antenna connector and/or integral antennas. Equipment designed for use with an integral antenna may be supplied with a temporary or permanent internal connector for the purpose of testing, providing the characteristics being measured are not expected to be affected.

If equipment, which is available on the market, is required to be checked it should be tested in accordance with the methods of measurement specified in the present document.

Clauses 1 and 3 provide a general description on the types of equipment covered by the present document and the definitions and abbreviations used. Clause 4 provides as a guide the number of samples required in order that type tests may be carried out and any markings on the equipment which the applicant has to provide.

Clauses 5 and 6 provide general test conditions to be used.

Clauses 7 and 8 specify the spectrum utilization parameters which are required to be measured. These are maximum limits which have been chosen to minimize harmful interference to other equipment or services. The clauses provide details on how the equipment should be tested and the conditions which should be applied.

Clause 9 gives the maximum measurement uncertainty values.

Annex A provides normative specifications concerning radiated measurements.

Annexes B through E are normative graphical representations of Radio Frequency (RF) carrier current limits, H- and E-field strength carrier limits and spurious emission limits.

Annex F is normative describing the calculation guidelines for customized antennas.

Annex G is normative and details the parameters which are required to be measured for compliance with the EC Council Directive 89/336/EEC [1], ("the EMC Directive").

Annexes H and J are informative annexes describing test fixtures and E-fields.

1 Scope

The present document covers the minimum characteristics considered necessary for Short Range Devices (SRDs) in order to make the best use of the available frequencies.

The present document is a generic standard for the frequency band 9 kHz to 25 MHz for radio equipment and 9 kHz to 30 MHz for inductive loop systems, which may be superseded by specific standards covering specific applications.

The present document contains the technical characteristics for radio equipment and is referencing CEPT/ERC Decisions and Recommendation for SRDs CEPT/ERC Recommendation 70-03 [3].

The present document does not necessarily include all the characteristics which may be required by a user, nor does it necessarily represent the optimum performance achievable.

The present document applies to generic SRDs which are not covered by other specific product standards such as:

- inductive loop systems;
- with an antenna connection and/or with an integral antenna;
- for alarms, identification systems, telecommand, telemetry, etc.;
- applications with or without speech.

The parameters in clauses 7 and 8 of the present document are considered as spectrum utilization parameters. It is intended that these parameters will be measured by an accredited test laboratory for the purpose of type testing and approval.

The present document covers fixed stations, mobile stations and portable stations. If a system includes transponders, these are measured together with the transmitter.

All types of modulation for radio devices are covered by the present document, provided the requirements of subclause 7.3 are met.

Three types of measuring methods are defined in the present document due to the varied nature of the types of equipment used in this band. One method measures the RF carrier current, another measures the radiated H-field and the third the conducted power.

On non-harmonized parameters, national administrations may impose conditions on the type of modulation, frequency, channel / frequency separations, maximum transmitter radiated field strength / maximum output current to a defined antenna, duty cycle, equipment marking and the inclusion of an automatic transmitter shut-off facility, as a condition for the issue of an individual or general licence, or as a condition for use under licence exemption.

The present document covers requirements for radiated emissions below as well as above 30 MHz.

Additional standards or specifications may be required for equipment such as that intended for connection to the Public Switched Telephone Network (PSTN).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".
- [2] CEPT/ERC Recommendation T/R 01-06: "Procedures for type testing and approval for radio equipment intended for non-public systems".
- [3] CEPT/ERC Recommendation 70-03 (1997): "Relating to the use of Short Range Devices (SRD)".
- [4] ETR 028: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [5] ETS 300.683 (1997): "Radio Equipment and Systems (RES); ElectroMagnetic Compatibility (EMC) standard for Short Range Devices (SRD) operating on frequencies between 9 kHz and 25 GHz".
- [6] ITU-T Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

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3 Definitions, symbols and abbreviations

3.1 Definitions

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

alarm: use of radio communication for indicating an alarm condition at a distant location.

artificial antenna: tuned reduced-radiating dummy load equal to the nominal impedance specified by the applicant.

assigned frequency band: frequency band within which the device is authorized to operate.

conducted measurements: measurements which are made using a direct connection to the equipment under test.

customized antenna: antenna build according to manufacturers antenna design rules inside type tested limits.

dedicated antenna: removable antenna supplied and type tested with the radio equipment, designed as an indispensable part of the equipment.

fixed station: equipment intended for use in a fixed location.

H-field test antenna: electrically screened loop or equivalent antenna, with which the magnetic component of the field can be measured.

identification system: equipment consisting of a transmitter(s), receiver(s) (or a combination of the two) and an antenna(s) to identify objects by means of a transponder.

integral antenna: permanent fixed antenna, which may be build-in, designed as an indispensable part of the equipment.

magnetic dipole moment: product of (Number of coil turns) \times (coil area) \times (coil current). (Air coils only)

mobile station: equipment normally installed in a vehicle.

portable station: equipment intended to be carried, attached or implanted.

radiated measurements: measurements which involve the absolute measurement of a radiated field.

telecommand: use of radio communication for the transmission of signals to initiate, modify or terminate functions of equipment at a distance.

telemetry: use of radio communication for indicating or recording data at a distance.

transponder: device, that responds to an interrogation signal.

3.2 Symbols

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

E	Electrical field strength
E _o	Reference electrical field strength, (see annex A)
f	Frequency
H	Magnetic field strength
H _o	Reference magnetic field strength, (see annex A)
m	Magnetic dipole moment
P	Power
R	Distance
R _o	Reference distance, (see annex A)
t	Time

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3.3 Abbreviations

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

EMC	ElectroMagnetic Compatibility
ISM	Industrial, Scientific and Medical
RF	Radio Frequency
SRD	Short Range Device
VSWR	Voltage Standing Wave Ratio

4 General

4.1 Presentation of equipment for testing purposes

Each equipment submitted for testing shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

The applicant shall complete the appropriate application form when submitting the equipment for testing. Also, the applicant shall declare the frequency ranges, the range of operating conditions and power requirements, as applicable, to establish the appropriate test conditions.

Additionally, technical documentation and operating manuals, sufficient to make the test, shall be supplied.

A test fixture for equipment with an integral antenna may be supplied by the applicant (see subclauses 6.3). For equipment supplied without an antenna i.e. Class 3, the applicant will supply either a tuned reduced radiating load (see subclause 6.2.1) or an artificial antenna as defined by annex H).

If an equipment is designed to operate with different radiated field strengths, measurement of each transmitter parameter shall be performed, according to the present document, on samples of equipment defined in subclause 4.1.1.

4.1.1 Choice of model for testing

The applicant shall provide one or more samples of the equipment, as appropriate for testing.

Stand alone equipment shall be offered by the applicant complete with any ancillary equipment needed for testing.

If an equipment has several optional features, considered not to affect the RF parameters then the tests need only to be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the applicant and agreed by the test laboratory.

4.1.2 On-site testing

In certain cases it may not be possible to provide representative samples of antennas and/or equipment due to physical constraints. In these cases equivalent measurements to the present document shall be made at a representative installation of the equipment (on-site).

4.2 Mechanical and electrical design

4.2.1 General

The equipment submitted by the applicant should be designed, constructed and manufactured in accordance with sound engineering practice and with the aim of minimizing harmful interference to other equipment and services.

Transmitters and receivers may be individual or combination units.

4.2.2 Controls

Those controls which, if maladjusted, might increase the interfering potentialities of the equipment shall not be easily accessible to the user.

4.2.3 Transmitter shut-off facility

If the transmitter is equipped with an automatic transmitter shut-off facility, it should be made inoperative for the duration of the test.

4.2.4 Receiver mute or squelch

If the receiver is equipped with a mute, squelch or battery-saving circuit, this circuit shall be made inoperative for the duration of the tests.

4.2.5 Marking (equipment identification)

The equipment shall be marked in a visible place. This marking shall be legible and durable. Where this is not possible due to physical constraints, the marking shall be included in the users manual.

4.2.5.1 Equipment identification

The marking shall include as a minimum:

- the name of the manufacturer or his trade mark;
- the type designation.

4.2.5.2 Regulatory marking

The equipment shall be marked, where applicable, in accordance with CEPT/ERC Recommendation 70-03 [3]. Where this is not applicable the equipment shall be marked in accordance with the National Regulatory requirements.

4.3 Declarations by the applicant

When submitting equipment for type testing, the applicant shall supply the necessary information required by the appropriate application form.

The performance of the equipment submitted for type testing shall be representative of the performance of the corresponding production model.

4.4 Auxiliary test equipment

All necessary test signal sources and set-up information shall accompany the equipment when it is submitted for type testing.

4.5 Interpretation of the measurement results

The interpretation of the results recorded on the appropriate test report for the measurements described in the present document shall be as follows:

- the measured value relating to the corresponding limit shall be used to decide whether an equipment meets the requirements of the present document;
- the measurement uncertainty value for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall, for each measurement, be equal to, or lower than, the figures in the table of measurement uncertainty (clause 9).

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5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

Type testing shall be made under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in subclauses 5.2 to 5.4.

5.2 Test power source

The equipment shall be tested using the appropriate test power source as specified in subclauses 5.2.1 or 5.2.2. Where equipment can be powered using either external or internal power sources, then the equipment shall be tested using the external power source as specified in subclause 5.2.1 then repeated using the internal power source as specified in subclause 5.2.2.

The test power source used shall be stated in the test report.

5.2.1 External test power source

During type tests, the power source of the equipment shall be replaced by an external test power source capable of producing normal and extreme test voltages as specified in subclauses 5.3.2 and 5.4.2. The internal impedance of the external test power source shall be low enough for its effect on the test results to be negligible. For the purpose of the

tests, the voltage of the external test power source shall be measured at the input terminals of the equipment. The external test power source shall be suitably de-coupled as close to the equipment battery terminals as practicable. For radiated measurements any external power leads should be so arranged so as not to affect the measurements.

During tests the test power source voltages shall be within a tolerance of $< \pm 1\%$ relative to the voltage at the beginning of each test. The value of this tolerance can be critical for certain measurements. Using a smaller tolerance will provide a better uncertainty value for these measurements.

5.2.2 Internal test power source

For radiated measurements on portable equipment with integral antenna, fully charged internal batteries should be used. The batteries used should be as supplied or recommended by the applicant. If internal batteries are used, at the end of each test the voltage shall be within a tolerance of $< \pm 5\%$ relative to the voltage at the beginning of each test.

If appropriate, for conducted measurements or where a test fixture is used, an external power supply at the required voltage may replace the supplied or recommended internal batteries. This shall be stated on the test report.

5.3 Normal test conditions

5.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature $+15^{\circ}\text{C}$ to $+35^{\circ}\text{C}$;
- relative humidity 20 % to 75 %.

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When it is impracticable to carry out tests under these conditions, a note to this effect, stating the ambient temperature and relative humidity during the tests, shall be added to the test report.

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5.3.2 Normal test power source

5.3.2.1 Mains voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages, for which the equipment was designed.

The frequency of the test power source corresponding to the ac mains shall be between 49 Hz and 51 Hz.

5.3.2.2 Regulated lead-acid battery power sources

When the radio equipment is intended for operation with the usual types of regulated lead-acid battery power source, the normal test voltage shall be 1,1 multiplied by the nominal voltage of the battery (e.g. 6 V, 12 V etc.).

5.3.2.3 Other power sources

For operation from other power sources or types of battery (primary or secondary), the normal test voltage shall be that declared by the equipment applicant and agreed by the accredited test laboratory. Such values shall be stated in the test report.