SLOVENSKI STANDARD
PSIST ETR 273-1-1:1999

01-april-1999

Elektromagnetna združljivost (EMC) in zadeve v zvezi z radijskim spektrom (ERM) - Izboljšanje zvezdastih merilnih metod (z uporabo merilnih mest) in ovrednotenje ustreznih merilnih negotovosti - 1. del: Netočnosti pri merjenju karakteristik mobilnih radijskih naprav - 1. podpoglavje: Uvod

ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 1: Uncertainties in the measuremement of mobile radio equipment characteristics; Sub-part 1: Introduction

Ta slovenski standard je istoveten z: **ETR 273-1-1 Edition 1**

ICS:

33.060.01	Radijske komunikacije na splošno	Radiocommunications in general
33.100.01	Elektromagnetna združljivost na splošno	Electromagnetic compatibility in general

PSIST ETR 273-1-1:1999 **en**

ETSI TECHNICAL REPORT

ETR 273-1-1

February 1998

Source: ERM

Reference: DTR/ERM-RP01-018-1-1

ICS: 33.020

Key words: Analogue, data, measurement uncertainty, mobile, radio, testing

Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 1: Uncertainties in the measurement of mobile radio equipment characteristics; Sub-part 1: Introduction

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 4 92 94 42 00 - Fax: +33 4 93 65 47 16

Contents

Blank page

Foreword

This ETSI Technical Report (ETR) has been produced by the Electromagnetic compatibility and Radio spectrum Matters (ERM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

The present document is part 1 of a multi-part Technical Report (ETR) covering Electromagnetic compatibility and Radio Spectrum Matters (ERM) Improvement of radiated methods of *measurement* (using test sites) and evaluation of the corresponding measurement uncertainties, as identified below:

Part 1-1: **"Uncertainties in the measurement of mobile radio equipment characteristics; Sub-part 1: Introduction";**

Part 1-2: "Uncertainties in the measurement of mobile radio equipment characteristics; Sub-part 2: Examples and annexes";

Part 2: "Anechoic chamber";

Part 3: "Anechoic chamber with a ground plane";

Part 4: "Open area test site";

Part 5: "Striplines";

Part 6: "Test fixtures";

Part 7: "Artificial human beings".

Introduction

The current-day accuracy of radiated tests on radio equipment leaves something to be desired. It is believed that currently some measurements can be subject to as much as ±15 dB uncertainty. This means that a manufacturer with an equipment which is marginal as far as, for example, spurious emission levels are concerned, could possibly send a test item to a number of test houses in the certain knowledge that one of them will pass it. As an illustration of the existing accuracy, a test house invited to participate in Round Robin tests organized as part of this project, whilst declining the invitation to take part, volunteered the information that they could measure within ±10 dB and they had the results to prove it (i.e. they were proud that they could achieve that accuracy).

NOTE: ±10 dB means that for a transmitter with nominal 1 W carrier power level, a measured level anywhere between 100 mW and 10 W could be achieved.

In some cases engineers claim uncertainties of lower magnitude i.e. 2 or 3 dB. An examination of the breakdown of the information available showed that different take different components into account, i.e. there was no standard list of which "what uncertainty components to include".

The attached documentation is the outcome of the project team's investigation into the uncertainties involved in radiated measurements and the information provided is divided as follows:

1) sources of uncertainty are identified for all types of test facility commonly used for radiated tests (i.e. anechoic chambers, anechoic chambers with ground planes, open area test sites, striplines as well as devices used to assist testing, namely test fixtures and artificial human bodies such as salty columns);

2) means of calculating/deriving the magnitudes of the uncertainties for individual facilities;

3) verification procedures for all test facilities (at the 1,5m test height);

4) revised radiated test methods.

It is true that, historically, a lot of radiated tests have been carried out using the so-called direct field method which is a one pass test and relies entirely on the calculation of the theoretical path loss between EUT and antenna (performed using actual separation distance, frequency, etc.). This is a notoriously inaccurate method and takes no account of reflections, mutual coupling, ambient signals, etc.

All the test methods presented in this ETR are so-called substitution measurements which are two stage tests which replace/compare the unknown EUT with a known antenna. Since most communications devices tend to be omni-directional in the azimuth plane, the known antenna is usually a dipole. It is assumed, and indeed is a largely correct assumption, that whatever interfering objects, signals, etc., affect a dipole similarly affect the test device. In this way, a large number of systematic measurement uncertainties have no net effect on a test since any offset is present in both the test and substitution stages.

1 Scope

This ETSI Technical Report (ETR) gives the general background to the subject of measurement uncertainty and proposes extensions and improvements relevant to radiated measurements. It also details the methods of radiated measurements (test methods for mobile radio equipment parameters and verification procedures for test sites) and provides the methods of evaluating the associated measurement uncertainties.

This ETR provides a method to be applied to all the applicable standards and ETRs, and supports ETR 027 [10].

2 References

Within this ETR, the following references apply:

[1] ANSI C63.5 (1988): "Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas".

[2] "Antenna engineering handbook", R. C. Johnson, H. Jasik.

[3] "Antennas", John D. Kraus, Second edition, McGraw Hill.

[4] "Antennas and radio wave propagation", R. E. Collin, McGraw Hill.

[5] "Antenna theory", C. Balanis, J. E. Wiley 1982.

[6] CCITT Recommendation O.41: "Psophometer for use on telephone-type circuits".

[7] CCITT Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

[8] "Control of errors on Open Area Test Sites", A. A. Smith Jnr. EMC technology October 1982 page 50-58.

[9] EN 55020: "Electromagnetic immunity of broadcast receivers and associated equipment".

[10] ETR 027 (1991): "Radio Equipment and Systems (RES); Methods of measurement for private mobile radio equipment".

[11] ETR 028 - Edition 2 (1994): "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".

[12] ETR 273-1-2 (1998): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 1: Uncertainties in the measurement of mobile radio equipment characteritics; Sub-part 2: Examples and annexes".

[13] ETR 273-5 (1998): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 5: Striplines".

[14] "Guide to the Expression of Uncertainty in Measurement", International Organization for Standardization, Geneva, Switzerland, 1995.

[15] IEC 60050-161 (1990): "International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility".

[16] The new IEEE standard dictionary of electrical and electronic terms, Fifth edition, IEEE Piscataway, NJ USA 1993.

[17] Recommendation INC-1 (1980).

[18] "Wave transmission", F. R. Conner, Arnold 1978.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Audio Frequency (AF) load: Normally a resistor of sufficient power rating to accept the maximum audio output power from the EUT. The value of the resistor is normally that stated by the manufacturer and is normally the impedance of the audio transducer at 1 000 Hz.

NOTE 1: In some cases it may be necessary to place an isolating transformer between the output terminals of the receiver under test and the load.

A-M1: A test modulation consisting of a 1 000 Hz tone at a level which produces a deviation of 12 % of the channel separation.

A-M2: A test modulation consisting of a 1 250 Hz tone at a level which produces a deviation of 12 % of the channel separation.

A-M3: A test modulation consisting of a 400 Hz tone at a level which produces a deviation of 12 % of the channel separation. This signal is used as an unwanted signal for analogue and digital measurements.

AF termination: Any connection other than the audio frequency load which may be required for the purpose of testing the receiver. (i.e. in a case where it is required that the bit stream be measured, the connection may be made, via a suitable interface, to the discriminator of the receiver under test).

NOTE 2: The termination device is normally agreed between the manufacturer and the testing authority and details included in the test report. If special equipment is required then it is normally provided by the manufacturer.

antenna: That part of a transmitting or receiving system that is designed to radiate or to receive electromagnetic waves.

antenna factor: Quantity relating the strength of the field in which the antenna is immersed to the output voltage across the load connected to the antenna. When properly applied to the meter reading of the measuring instrument, yields the electric field strength in V/m or the magnetic field strength in A/m.

antenna gain: The ratio of the maximum radiation intensity from an (assumed lossless) antenna to the radiation intensity that would be obtained if the same power were radiated isotropically by a similarly lossless antenna.

bit error ratio: The ratio of the number of bits in error to the total number of bits.

combining network: A multipole network allowing the addition of two or more test signals produced by different sources for connection to a receiver input.

NOTE 3: Sources of test signals are normally connected in such a way that the impedance presented to the receiver is 50 Ω. The combining networks are designed so that effects of any intermodulation products and noise produced in the signal generators are negligible.

correction factor: The numerical factor by which the uncorrected result of a measurement is multiplied to compensate for an assumed systematic error.

confidence level: The probability of the accumulated error of a measurement being within the stated range of uncertainty of measurement.

directivity: The ratio of the maximum radiation intensity in a given direction from the antenna to the radiation intensity averaged over all directions (i.e. directivity = antenna gain + losses).

DM-0: A test modulation consisting of a signal representing an infinite series of "0" bits.

DM-1: A test modulation consisting of a signal representing an infinite series of "1" bits.

DM-2: A test modulation consisting of a signal representing a pseudorandom bit sequence of at least 511 bits in accordance with CCITT Recommendation O.153 [7].

D-M3: A test signal agreed between the testing authority and the manufacturer in the cases where it is not possible to measure a bit stream or if selective messages are used and are generated or decoded within an equipment.

NOTE 4: The agreed test signal may be formatted and may contain error detection and correction. Details of the test signal are be supplied in the test report.

duplex filter: A device fitted internally or externally to a transmitter/receiver combination to allow simultaneous transmission and reception with a single antenna connection.

error of measurement (absolute): The result of a measurement minus the true value of the measurand.

error (relative): The ratio of an error to the true value.

estimated standard deviation: From a sample of n results of a measurement the estimated standard deviation is given by the formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

x_i being the i^{th} result of measurement (i = 1,2,3, ...,n) and $\bar{x}$ the arithmetic mean of the n results considered.

A practical form of this formula is:

$$\sigma = \sqrt{\frac{Y - \frac{X^2}{n}}{n-1}}$$

Where X is the sum of the measured values and Y is the sum of the squares of the measured values.

extreme test conditions: Conditions defined in terms of temperature and supply voltage. Tests are normally made with the extremes of temperature and voltage applied simultaneously. The upper and lower temperature limits are specified in the relevant testing standard. The test report states the actual temperatures measured.

error (of a measuring instrument): The indication of a measuring instrument minus the (conventional) true value.