
**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 - 2. podpoglavje: Primeri in dodatki**

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 2: Examples and annexes

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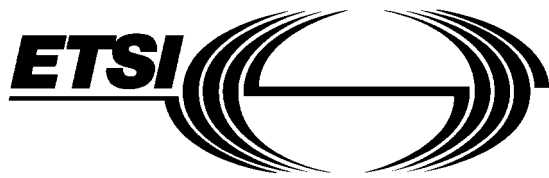
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Improvement of radiated methods of
measurement (using test sites) and
evaluation of the corresponding
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Part 1: Uncertainties in the measurement
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Foreword

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";

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1 Scope

This ETSI Technical Report (ETR) provides the methods of evaluating and calculating the measurement uncertainties and the required corrections for measurement conditions and results.

This ETR covers the method of radiated measurements on mobile radio equipment and applies to the assessment of the uncertainties of radiated measurements.

The following aspects relate to the measurements:

- the calculation of the total uncertainty for each of the measured parameters;
- recommended maximum acceptable uncertainties for each of the measured parameters.

This ETR provides a method to be applied to all the applicable standards, and supports ETSI Technical Report ETR 027 [4] and is supported by ETR 028 [5].

2 References

Within this ETR the following references apply:

- [1] CCITT Recommendation O.41 (10/94): "Psophometer for use on telephone-type circuits".
- [2] CCITT Recommendation O.153 (10/92): "Basic parameters for the measurement of error performance at bit rates below the primary rate".
- [3] EN 55020 "Electromagnetic immunity of broadcast receivers and associated equipment".
- [4] ETR 027: "Radio Equipment and System (RES); Methods of measurement for private mobile radio equipment".
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- [5] ETR 028: "Radio Equipment and System (RES); Uncertainties in the measurement of mobile radio equipment characteristics".
- [6] ETR 273-1-1 "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: Introduction".
- [7] "Guide to the Expression of Uncertainty in Measurement" (International Organisation for Standardisation, Geneva, Switzerland, 1995).

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.

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.

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.

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 . Combining networks are so designed that 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).

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

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 [2].

DM-3: 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 should be supplied in the test report.

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 ($i = 1, 2, 3, \dots, n$) and \bar{x} the arithmetic mean of the n results considered.

A practical form of this formula is:

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

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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.

free field: A field (wave or potential) which has a constant ratio between the electric and magnetic field intensities.

free Space: A region free of obstructions and characterized by the constitutive parameters of a vacuum.

impedance: A measure of the complex resistive and reactive attributes of a component in an alternating current circuit.

impedance (wave): The complex factor relating the transverse component of the electric field to the transverse component of the magnetic field at every point in any specified plane, for a given mode.

influence quantity: A quantity which is not the subject of the measurement but which influences the value of the quantity to be measured or the indications of the measuring instrument.

intermittent operation: Operation where the manufacturer states the maximum time that the equipment is intended to transmit and the necessary standby period before repeating a transmit period.

isotropic radiator: A hypothetical, lossless antenna having equal radiation intensity in all directions.