

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Wireless microphones
in the 25 MHz to 3 GHz frequency range;
Part 1: Technical characteristics and
methods of measurement**

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI standards Two-step Approval Procedure.

The present document has been updated in line with the advances in radio microphone technology in the digital field and also with changes generated within CEPT in the former ERMES band for aids for the handicapped.

The present document is part 1 of a multi-part deliverable covering the Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range, as identified below:

- Part 1:** "Technical characteristics and methods of measurement";
- Part 2: "Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive".

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

Introduction

In preparing the present document, much attention has been given to assure a low interference probability, while at the same time allowing maximum flexibility and service to the end-user.

Common technical specifications and harmonized frequency allocations are expected to greatly reduce problems of interference and illegal use.

The present document is a testing standard based on spectrum utilization parameters and does not include performance characteristics that may be required by the user nor requirements for interfacing equipment.

In-ear monitoring systems may be tested to either the present document (< 200 kHz max. occupied bandwidth) or to EN 301 357-1 [4] (< 300 kHz max. occupied bandwidth) with due consideration of power and operating frequency. Consumer radio microphones with 300 kHz occupied bandwidth can also be tested to EN 301 357-1 [4].

Since the initial adoption of I-ETS 300 422 [5] there has been the introduction of further types of equipment into the market - cordless headphones/loudspeakers Low power Band II and consumer in-ear monitoring. These are low power wideband systems that have some characteristics in common with radio microphones but are not compatible with multichannel radio microphones. This equipment is covered by EN 301 357-1 [4].

Additional standards or specifications may be required for equipment intended to interface to the Public Switched Telephone Network (PSTN). This facility may be subjected to regulatory conditions.

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1 Scope

The present document covers the minimum characteristics considered necessary in order to make the best use of the available frequency spectrum for wireless microphones. The present document specifies the minimum performance requirements and the methods of measurement of Assistive Listening Devices, radio microphones and in-ear monitoring systems. It does not necessarily include all the characteristics that may be required by a user, nor does it necessarily represent the optimum performance achievable.

The present document applies to equipment operating on radio frequencies between 25 MHz and 3 GHz (as shown in table 1) using analogue, digital and hybrid (using both analogue and digital) modulation. The present document does not apply to radio microphones or in ear monitoring equipment employing Time Division Multiple Access (TDMA) modulation.

The maximum power recommended for equipment covered by the present document is 250 mW (erp below 1 GHz and eirp above 1 GHz). Equipment above 250 mW should be tested to EN 300 454-1 [6].

The present document also covers radio microphones used in the 863 MHz to 865 MHz band, with a maximum power of 10 mW.

Electromagnetic Compatibility (EMC) requirements are covered by EN 301 489-9 [7].

National regulations on maximum power output will apply or those detailed in the latest version of CEPT/ERC/REC 70-03 [11], annex 10 (see <http://www.ero-docdb.dk>).

Equipment	effective radiated power (erp) or conducted	
	Class 1	Class 2
Radio Microphones	> 250 mW	2 mW
In ear monitoring	> 250 mW	2 mW
Tour guide systems	10 mW	2 mW
Aids for the handicapped	10 mW	2 mW
Radio Microphones 863 MHz to 865 MHz	10 mW	10 mW

The classes of equipment given in the present document are as follows:

- class 1 equipment would normally be considered as a category requiring an operator licence;
- class 2 equipment would be considered in some countries as not requiring an operator licence.

The types of equipment covered by the present document are as follows:

- professional hand held radio microphones;
- professional body worn radio microphones;
- in ear monitoring systems;
- consumer radio microphones;
- tour guide systems; and
- Assistive Listening Devices (Aids for the handicapped).

Table 1: Radiocommunications service frequency bands

	Radiocommunications service frequency bands
Transmit	25 MHz to 3 000 MHz
Receive	25 MHz to 3 000 MHz

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
 - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
 - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] ITU-R Recommendation BS.559-2: "Objective measurement of radio-frequency protection ratios in LF, MF and HF broadcasting"
- [2] IEC 60244-13: "Methods of measurement for radio transmitters; Part 13: Performance characteristics for FM sound broadcasting".
- [3] ETSI TR 100 028 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM) Uncertainties in the measurement of mobile radio equipment characteristics".

2.2 Informative references

- [4] ETSI EN 301 357-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Cordless audio devices in the range 25 MHz to 2 000 MHz; Part 1: Technical characteristics and test methods".
- [5] ETSI I-ETS 300 422: "Radio Equipment and Systems (RES); Technical characteristics and test methods for wireless microphones in the 25 MHz to 3 GHz frequency range".
- [6] ETSI EN 300 454-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Wide band audio links; Part 1: Technical characteristics and test methods".
- [7] ETSI EN 301 489-9: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 9: Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio and in-ear monitoring devices".
- [8] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

- [9] ETSI TR 102 273: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".
- [10] ANSI C63.5: "American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electro Magnetic Interference".
- [11] CEPT/ERC/REC 70-03: "Relating to the use of Short Range Devices (SRD)".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

alignment range: See clause 5.1.2.

antenna port: port, where a radio frequency antenna is connected to equipment

base station equipment: radio and/or ancillary equipment intended for operation at a fixed location and powered directly or indirectly

EXAMPLE: Via an ac/dc converter or power supply) by the ac mains network, or an extended local dc mains network.

class of emission: set of characteristics of an emission, designated by standard symbols, e.g. type of modulation of the main carrier, modulating signal, type of information to be transmitted, and also, if appropriate, any additional signal characteristics

conducted measurements: measurements that are made using a direct connection to the EUT

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

enclosure port: physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

NOTE: In the case of integral antenna equipment, this port is inseparable from the antenna port.

frequency stability: the spontaneous and/or environmentally caused frequency change within a given time interval

integral antenna: antenna, with or without a connector, designed as, and declared as by the manufacturer, an indispensable part of the equipment

integral microphone: microphone, designed as, and declared as by the manufacturer, an indispensable fixed part of the equipment

limiter threshold: audio input or output level at which the transmitter audio limiter action may be said to commence

NOTE: It is specified with any accessible variable gain controls set according to the manufacturer's instructions, with a sinusoidal input signal of 500 Hz.

mean power (of a radio transmitter): average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions

mobile equipment: receiver, transmitter or transmitter/receiver (transceiver) intended for installation and use in a vehicle, and powered by the main battery of the vehicle

modulation schemes:

- analogue modulation: any modulation scheme without discrete constellation points (e.g. FM);
- digital modulation: any modulation scheme with discrete constellation points (e.g. FSK, PSK);

- hybrid systems: will be classified as analogue or digital device depending on the RF- modulation scheme e.g. analogue modulation with digital pre-processing.

necessary bandwidth: for a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions

out-of-band emission: emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions

port: any connection point on or within the Equipment Under Test (EUT) intended for the connection of cables to or from that equipment

portable equipment: radio and/or ancillary equipment intended for portable (e.g. handheld) operation, powered by its own integral battery

radiated measurements: measurements that involve the absolute measurement of a radiated electromagnetic field

Radio Frequency (RF) port: any connection point on or within the EUT intended for the connection of RF cables

NOTE: RF ports are treated as 50 Ω connection points unless otherwise specified by the manufacturer.

radio receiver: item of electronic equipment designed to receive electromagnetic radio frequency emissions

rated output power: mean power that the transmitter shall deliver at its antenna port under the manufacturer's specified conditions of operation. For the purposes of the present document this shall be quoted as erp below 1 GHz and eirp above 1 GHz.

spurious emissions: emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out of band emissions

switching range: See clause 5.1.2.

3.2 Symbols

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

λ	wavelength in metres
μF	microFarad
μW	microWatt
Ω	ohm

3.3 Abbreviations

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

ac	alternating current
B	declared channel Bandwidth

NOTE: See table 2.

AF	Audio Frequency
BN	Necessary Bandwidth
dBc	dB relative to the carrier level
dc	direct current
eirp	equivalent isotropically radiated power
erp	effective radiated power
EUT	Equipment Under Test
fc	centre frequency
GHz	GigaHertz
kHz	kiloHertz
LF	Low Frequency

lim	limiting
MHz	MegaHertz
mW	milliWatt
OATS	Open Area Test Site
PSTN	Public Switched Telephone Network
R	distance
RBW	Resolution BandWidth
RF	Radio Frequency
TDMA	Time Division Multiple Access
TR	Transient phenomena applied to Receivers
Tx	Transmitter
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio

4 Functional characteristics

4.1 Radio microphone descriptions

Radio microphones are used to provide a high quality, short range, wireless link for use in audio performance for professional use in broadcasting, concerts, etc. The radio part of the transmitter and receiver shall be made up exclusively from equipment that has been approved according to the present document.

Other equipment that may be connected to radio microphones shall fulfil the standards applicable to that equipment (if any).

4.2 In ear monitoring

In ear monitoring equipment is used by stage and studio performers to receive personal fold back (monitoring) of the performance. This can be just their own voice or a complex mix of sources. The bandwidth requirement of professional in ear monitoring equipment is similar to those of radio microphones.

The radio part of the transmitter and receiver shall be made up exclusively from equipment that has been approved according to the present document.

Other equipment that may be connected to in ear monitoring equipment shall fulfil the standards applicable to that equipment (if any).

4.3 Assistive Listening Devices (Aids for the handicapped)

Hearing impaired persons use hearing aids, which are electro acoustic amplifiers including a microphone and a loudspeaker and having frequency response and dynamic characteristics specific to each hearing loss. A wireless solution for connecting an external remote microphone to the hearing aid could be realized with a narrow band FM transmitter operating in the frequency range 169,4 MHz to 220 MHz in combination with an FM receiver. The FM transmitter could be handheld, put around the neck by using a neckloop or put on a table in front of a speaker, a teacher or other persons whose voice would not be captured without this help because of the surrounding acoustic noise. The radio part of the FM transmitter and receiver shall comply with the requirements of the present document. In case that the FM transmitter has integrated equipment providing additionally inductive remote control for hearing instruments or connectivity to Bluetooth compatible cellular phones, the transmitter should fulfil also the standards applicable for that equipment.