

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Land Mobile Service;  
Radio equipment using integral antennas  
intended primarily for analogue speech;  
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 ETSI standards One-step Approval Procedure.

The present document is part 1 of a multi-part deliverable covering the Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech, 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".

<b>Proposed national transposition dates</b>	
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

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# 1 Scope

The present document covers the minimum characteristics considered necessary in order to avoid harmful interference and to make acceptable use of the available frequencies.

The present document applies to equipment with integral antennas, used in angle modulation systems in the land mobile service, operating on radio frequencies between 30 MHz and 1 000 MHz, with channel separations of 12,5 kHz, 20 kHz and 25 kHz, and is intended primarily for analogue speech.

In the present document different requirements are given for the different radio frequency bands, channel separations, environmental conditions and types of equipment, where appropriate.

The present document is complementary to EN 300 086 [i.7], which covers radio equipment with an internal or external RF connector, for use in the land mobile service.

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## 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.

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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] ETSI TR 100 028 (V1.4.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [2] ANSI C63.5 (2006): "American National Standard for Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas (9 kHz to 40 GHz)".

### 2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] CEPT/ERC/REC 74-01E: "Unwanted emissions in the spurious domain" (Siófok 1998, Nice 1999, Sesimbra 2002; Hradec Kralove 2005).

- [i.2] ETSI EN 300 793 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Presentation of equipment for type testing".
- [i.3] ETSI TR 102 273 (V1.2.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".
- [i.4] IEC 60489-3 (1988): "Methods of measurement for radio equipment used in the mobile services; Part 3: Receivers for A3E or F3E emissions".
- [i.5] ITU-T Recommendation O.41 (1994): "Psophometer for use on telephone-type circuits".
- [i.6] 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).
- [i.7] ETSI EN 300 086 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech".

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

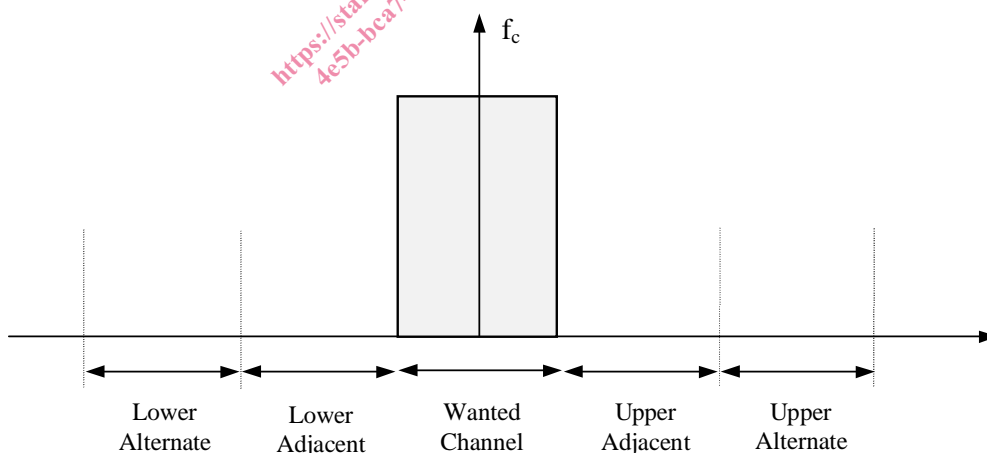
For the purposes of the present document, the following terms and definitions apply:

**50  $\Omega$ :** 50 ohm non-reactive impedance

**angle modulation:** either phase modulation or frequency modulation

**adjacent and alternate channels:**

- The adjacent channels are those two channels offset from the wanted channel by the channel spacing.
- The alternate channels are those two channels offset from the wanted channel by double the channel spacing.



**Figure 1: Adjacent and alternate channel definitions**

**audio frequency load:** resistor, or suitable alternative, having a value equal to the impedance of the audio transducer at 1 000 Hz, as stated by the manufacturer/provider, and of sufficient power rating to accept the maximum audio output power from the equipment under test

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



**audio frequency termination:** any connection other than the audio frequency load which may be required for the purpose of testing the receiver

NOTE: The termination device should be, as appropriate, either chosen by the manufacturer or agreed between the manufacturer and the testing laboratory and details included in test reports. If special equipment is required then it should be provided by the manufacturer.

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

**integral antenna:** antenna designed to be connected to the equipment without the use of a 50  $\Omega$  external connector and considered to be part of the equipment

NOTE: An integral antenna may be fitted internally or externally to the equipment.

**Listen Before Transmit mode (LBT):** monitoring mode in which the RF channel is checked for activity before transmitting.

**psophometric weighting network:** psophometric weighting network is described in ITU-T Recommendation O.41 [i.5]

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

**SINAD Meter:** measurement instrument used to measure SND/ND using a band-stop filter

NOTE: As defined in annex D.

## 3.2 Symbols

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

dBc	dB relative to the carrier power
$f_{I1}$	1 <sup>st</sup> intermediate frequency
$f_{I2}$	2 <sup>nd</sup> intermediate frequency
$f_{In}$	n <sup>th</sup> intermediate frequency
$f_l$	frequency of the limited frequency range
$f_{LO}$	Local oscillator frequency
$V_{min}$	Minimum extreme test voltage
$V_{max}$	Maximum extreme test voltage
$T_{min}$	Minimum extreme test temperature
$T_{max}$	Maximum extreme test temperature

## 3.3 Abbreviations

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

CSP	Channel separation
emf	electro-motive force
EUT	Equipment Under Test
IF	Intermediate Frequency
LBT	Listen Before Transmit
MPFD	Maximum Permissible Frequency Deviation
OATS	Open Area Test Site
RF	Radio Frequency
rms	root mean squared
Rx	Receiver
SINAD	Received signal quality based on (Signal + Noise + Distortion) / (Noise + Distortion)
SND/ND	(signal + noise + distortion)/(noise + distortion)
SR	Switching Range
Tx	Transmitter
VSWR	Voltage Standing Wave Ratio

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## 4 General

### 4.1 Selection of equipment for testing purposes

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

The provider or manufacturer 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.

Guidance on the presentation of equipment is also given in EN 300 793 [i.2].

### 4.2 Mechanical and electrical design

#### 4.2.1 General

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

#### 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

When a timer for an automatic shut-off facility is operative, at the moment of the time-out the transmitter shall automatically be switched off. The activation of the transmitter key shall reset the timer.

A shut-off facility shall be inoperative for the duration of the measurements unless it has to remain operative to protect the equipment. If the shut-off facility is left operative the status of the equipment shall be indicated.

### 4.3 Marking

The equipment shall be marked in a visible place. This marking shall be legible, tamperproof and durable.

The marking shall be in accordance with EC Directives and/or CEPT decisions or recommendations as appropriate.

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## 5 Test conditions, power sources and ambient temperatures

### 5.1 Normal and extreme test conditions

Testing shall be performed under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in clauses 5.2 to 5.5.

## 5.2 Test power source

During testing the power source of the equipment shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in clauses 5.3.2 and 5.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

For battery operated equipment the battery shall be removed and the test power source shall be applied as close to the battery terminals as practicable.

During tests of DC powered equipment the power source voltages shall be maintained within a tolerance of  $< \pm 1$  % relative to the voltage at the beginning of each test. The value of this tolerance is critical for power measurements. Using a smaller tolerance will provide better measurement uncertainty values.

## 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 °C to +35 °C;
- relative humidity: 20 % to 75 %.

When it is impracticable to carry out the 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.

### 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 used on vehicles

When the radio equipment is intended for operation from the usual types of regulated lead-acid battery power source used on vehicles the normal test voltage shall be 1,1 times the nominal voltage of the battery (for nominal voltages of 6 V and 12 V, these are 6,6 V and 13,2 V respectively).

#### 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 manufacturer.

## 5.4 Extreme test conditions

### 5.4.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in clause 5.5, at the upper and lower temperatures of one of the following two ranges:

- -20 °C to +55 °C;  
All mobile and handportable equipment.  
Base stations for outdoor/uncontrolled climate conditions.
- 0 °C to +40 °C;  
Base stations for indoor/controlled climate conditions.

In the case of base station equipment, the manufacturer shall declare which conditions the equipment is intended to be installed in.

### 5.4.2 Extreme test source voltages

#### 5.4.2.1 Mains voltage

The extreme test voltage for equipment to be connected to an ac mains source shall be the nominal mains voltage  $\pm 10\%$ .

#### 5.4.2.2 Regulated lead-acid battery power sources used on vehicles

When the equipment is intended for operation from the usual types of regulated lead-acid battery power sources used on vehicles the extreme test voltages shall be 1,3 and 0,9 times the nominal voltage of the battery (for a nominal voltage of 6 V, these are 7,8 V and 5,4 V respectively and for a nominal voltage of 12 V, these are 15,6 V and 10,8 V respectively).

#### 5.4.2.3 Power sources using other types of batteries

The lower extreme test voltages for equipment with power sources using batteries shall be as follows:

- for the nickel metal-hydride, leclanché or lithium type: 0,85 times the nominal battery voltage;
- for the mercury or nickel-cadmium type: 0,9 times the nominal battery voltage.

No upper extreme test voltages apply.

In the case where no upper extreme test voltage the nominal voltage is applicable, the corresponding four extreme test conditions are:

- $V_{\min}/T_{\min}$ ,  $V_{\min}/T_{\max}$ ;
- $(V_{\max} = \text{nominal})/T_{\min}$ ,  $(V_{\max} = \text{nominal})/T_{\max}$ .

#### 5.4.2.4 Other power sources

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those declared by the equipment manufacturer.

## 5.5 Procedure for tests at extreme temperatures

Before measurements are made the equipment shall have reached thermal balance in the test chamber. The equipment shall be switched off during the temperature stabilizing period.

In the case of equipment containing temperature stabilization circuits designed to operate continuously, the temperature stabilization circuits may be switched on for 15 minutes after thermal balance has been obtained, and the equipment shall then meet the specified requirements. For such equipment the manufacturer shall provide for the power source circuit feeding the crystal oven to be independent of the power source for the rest of the equipment.

If the thermal balance is not checked by measurements, a temperature stabilizing period of at least one hour, or a longer period as may be decided by the testing laboratory, shall be allowed. The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

### 5.5.1 Procedure for equipment designed for continuous transmission

If the manufacturer states that the equipment is designed for continuous transmission, the test procedure shall be as follows.

Before tests at the upper extreme temperature, the equipment shall be placed in the test chamber, and left until thermal balance is attained. The equipment shall then be switched on in the transmit condition for a period of half an hour, after which the equipment shall meet the specified requirements.

Before tests at the lower extreme temperature, the equipment shall be left in the test chamber until thermal balance is attained, then switched to the standby or receive condition for a period of one minute, after which the equipment shall meet the specified requirements.

### 5.5.2 Procedure for equipment designed for intermittent transmission

If the manufacturer states that the equipment is designed for intermittent transmission, the test procedure shall be as follows.

Before tests at the upper extreme temperature, the equipment shall be placed in the test chamber, and left until thermal balance is attained. The equipment shall then be switched on for one minute in the transmit condition, followed by four minutes in the receive condition, after which the equipment shall meet the specified requirements.

For tests at the lower extreme temperature, the equipment shall be left in the test chamber until thermal balance is attained, then switched to the standby or receive condition for one minute, after which the equipment shall meet the specified requirements.

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## 6 General test conditions

### 6.1 Test signals

The test modulation signals are baseband signals that modulate a carrier or signal generator. They are dependent upon the type of equipment under test and also the measurement to be performed.

Test modulating signals are:

- A-M1: a 1 000 Hz tone at a level which produces a deviation of 12 % of the channel separation;
- A-M2: a 1 250 Hz tone at a level which produces a deviation of 12 % of the channel separation;
- A-M3: 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 normal test modulation, the modulation frequency shall be 1 kHz and the resultant frequency deviation shall be 60 % of the maximum permissible frequency deviation for the clause 7.3.3.

The test signal shall be substantially free from amplitude modulation.