

**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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Contents

Intellectual Property Rights	6
Foreword.....	6
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	8
3 Definitions, symbols and abbreviations	8
3.1 Definitions.....	8
3.2 Symbols.....	9
3.3 Abbreviations	10
4 General	10
4.1 Selection of equipment for testing purposes.....	10
4.2 Mechanical and electrical design.....	10
4.2.1 General.....	10
4.2.2 Controls	10
4.2.3 Transmitter shut-off facility.....	10
4.3 Marking.....	11
5 Test conditions, power sources and ambient temperatures	11
5.1 Normal and extreme test conditions	11
5.2 Test power source.....	11
5.3 Normal test conditions.....	11
5.3.1 Normal temperature and humidity.....	11
5.3.2 Normal test power source	11
5.3.2.1 Mains voltage.....	11
5.3.2.2 Regulated lead-acid battery power sources used on vehicles.....	12
5.3.2.3 Other power sources.....	12
5.4 Extreme test conditions	12
5.4.1 Extreme temperatures	12
5.4.2 Extreme test source voltages.....	12
5.4.2.1 Mains voltage.....	12
5.4.2.2 Regulated lead-acid battery power sources used on vehicles.....	12
5.4.2.3 Power sources using other types of batteries.....	12
5.4.2.4 Other power sources.....	13
5.5 Procedure for tests at extreme temperatures.....	13
5.5.1 Procedure for equipment designed for continuous transmission.....	13
5.5.2 Procedure for equipment designed for intermittent transmission	13
6 General test conditions	13
6.1 Test signals.....	13
6.2 Receiver mute or squelch facility	14
6.3 Artificial antenna.....	14
6.4 Test sites and general arrangements for radiated measurements	14
6.5 Arrangement for test signals at the input of the transmitter	14
6.6 Receiver rated audio output power.....	14
6.7 Reference for degradation measurements.....	14
6.7.1 Definition.....	14
6.7.2 Procedures for measurements using the test fixture.....	15
6.7.3 Procedures for measurements using the test site.....	15
7 Technical characteristics of the transmitter.....	15
7.1 Frequency error	15
7.1.1 Definition.....	15
7.1.2 Method of measurement	16
7.1.3 Limits.....	16

7.2	Effective radiated power	16
7.2.1	Definition	16
7.2.2	Method of measurement	17
7.2.2.1	Maximum effective radiated power under normal test conditions	17
7.2.2.2	Average effective radiated power under normal test conditions	18
7.2.2.3	Method of measurements of maximum and average effective radiated power under extreme test conditions	19
7.2.3	Limits	19
7.3	Maximum permissible frequency deviation	20
7.3.1	Definition	20
7.3.2	Method of measurement	20
7.3.2.1	Maximum permissible frequency deviation	21
7.3.2.2	Response of the transmitter to modulation frequencies above 3 kHz	21
7.3.3	Limits	21
7.3.3.1	Maximum permissible frequency deviation	21
7.3.3.2	Response of the transmitter to modulation frequencies above 3 kHz	21
7.4	Adjacent and alternate channel power	22
7.4.1	Definition	22
7.4.2	Method of measurement	22
7.4.3	Limits	24
7.5	Radiated unwanted emissions in the spurious domain	24
7.5.1	Definition	24
7.5.2	Method of measurement	24
7.5.3	Limits	26
8	Technical characteristics of the receiver	27
8.1	Average usable sensitivity (field strength, speech)	27
8.1.1	Definition	27
8.1.2	Methods of measurement	27
8.1.2.1	Method of measurement under normal test conditions	27
8.1.2.2	Method of measurement under extreme test conditions	29
8.1.3	Limits	29
8.2	Spurious radiations	30
8.2.1	Definition	30
8.2.2	Method of measurement	30
8.2.3	Limits	32
8.3	Co-channel rejection	32
8.3.1	Definition	32
8.3.2	Method of measurement	32
8.3.3	Limits	33
8.4	Adjacent channel selectivity	33
8.4.1	Definition	33
8.4.2	Method of measurement	33
8.4.3	Limits	34
8.5	Spurious response rejection	35
8.5.1	Definition	35
8.5.2	Method of measurement	35
8.5.2.1	Introduction to the method of measurement	35
8.5.2.2	Measurement arrangement	36
8.5.2.3	Method of the search	36
8.5.2.4	Measurement	37
8.5.3	Limits	38
8.6	Intermodulation response rejection	38
8.6.1	Definition	38
8.6.2	Method of measurement	38
8.6.3	Limits	39
8.7	Blocking or desensitization	40
8.7.1	Definition	40
8.7.2	Method of measurement	40
8.7.3	Limits	41
9	Measurement uncertainty	41

Annex A (normative):	Radiated measurement.....	43
A.1	Test sites and general arrangements for measurements involving the use of radiated fields	43
A.1.1	Anechoic chamber	43
A.1.2	Anechoic chamber with a conductive ground plane	44
A.1.3	Open Area Test Site (OATS)	45
A.1.4	Test antenna.....	46
A.1.5	Substitution antenna	46
A.1.6	Measuring antenna	47
A.2	Guidance on the use of radiation test sites	47
A.2.1	Verification of the test site	47
A.2.2	Preparation of the EUT.....	47
A.2.3	Power supplies to the EUT	47
A.2.4	Volume control setting for analogue speech tests	47
A.2.5	Range length.....	48
A.2.6	Site preparation	48
A.3	Coupling of signals.....	49
A.3.1	General	49
A.3.2	Data Signals.....	49
A.3.3	Speech and analogue signals	49
A.3.3.1	Acoustic coupler description.....	49
A.3.3.2	Calibration	50
A.4	Test fixture	50
A.4.1	Description	50
A.4.2	Calibration.....	51
A.4.3	Mode of use	51
Annex B (normative):	Specifications for adjacent channel power measurement arrangements.....	52
B.1	Power measuring receiver specification.....	52
B.1.1	General	52
B.1.2	IF filter	52
B.1.3	Oscillator and amplifier.....	54
B.1.4	Attenuation indicator.....	54
B.1.5	Level indicators	54
B.1.5.1	Rms level indicator	54
B.1.5.2	Peak level indicator.....	54
B.2	Spectrum analyzer for adjacent channel power measurement.....	54
Annex C (normative):	Spectrum Analyzer	56
C.1	Adjacent Channel Power Measurement	56
C.2	Unwanted Emissions Measurement	56
Annex D (normative):	Band-stop filter (for SINAD meter).....	57
History		58

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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 Public Enquiry phase of the ETSI standards Two-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 under 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
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Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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.

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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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 Ω : 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.

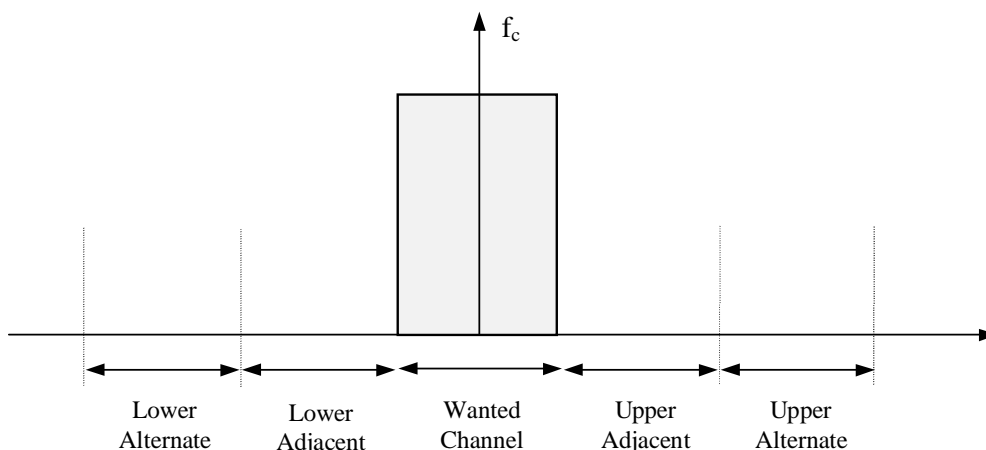


Figure 1: Adjacent and alternate channel definitions

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 Ω external connector and considered to be part of the equipment

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

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 as defined in annex D

3.2 Symbols

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

f_{I1}	1 st intermediate frequency
f_{I2}	2 nd intermediate frequency
f_{In}	n th 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:

dBc	dB relative to the carrier power
emf	electro-motive force
EUT	Equipment Under Test
IF	Intermediate Frequency
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

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.

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.

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;