

9`Y\_fca U[ bYfbUnXfi y`^j cgh]b`nUXYj Yj `nj Yn]`n`fUX]`g\_`ja `gdY\_fca `fØFAŁ!  
?cdYbg\_Y`a cV]bY`g`hcf]`h Y!`FUX]`g\_UcdfYa UnUUbUc[ bY`cn]fca UX][ ]HbY  
\_ca i b]\_UW`Y`ftfYbcg[ c] cfUcn]fca UdcXUh\_cj`ž\_]`XYi `Yj `cn\_cdUgcj b]`\_UbU]`  
]b`ja UUbhYbg\_]`\_cbY`hcf`!`%`XY.`HY b] bY`\_UfU`hYf]gh\_]`b`a Yf]`bY`a YtcXY

Electromagnetic compatibility and Radio spectrum Matters (ERM) - Land Mobile Service  
- Radio equipment for analogue and/or digital communication (speech and/or data) and  
operating on narrow band channels and having an antenna connector - Part 1: Technical  
characteristics and methods of measurement

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# ETSI EN 301 166-1 V1.3.2 (2009-11)

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*European Standard (Telecommunications series)*

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Land Mobile Service;  
Radio equipment for analogue and/or digital  
communication (speech and/or data) and operating on  
narrow band channels and having an antenna connector;  
Part 1: Technical characteristics and  
methods of measurement**

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## Reference

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REN/ERM-TGDMR-287-1

## Keywords

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mobile, PMR, radio, speech

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document is part 1 of a multi-part deliverable covering Land Mobile Service; Radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrow band channels and having an antenna connector, 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".

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National transposition dates	
Date of latest announcement of this EN (doa):	28 February 2010
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# 1 Scope

The present document covers the technical requirements for radio transmitters and receivers used in stations in the Private Mobile Radio (PMR) service. It applies to use in the land mobile service, operating on radio frequencies between 30 MHz and 3 GHz, with narrow channel separations (CSP) (less than 10 kHz) and intended for speech and/or data. It is the intention of the present document to cover any Channel Bandwidths (CBW) permitted by National Administrations for such systems, e.g. 6,25 kHz.

**Table 1: Radiocommunications service frequency bands**

Radiocommunications service frequency bands	
Transmit	30 MHz to 3 000 MHz
Receive	30 MHz to 3 000 MHz

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

In the present document, data transmission systems are defined as systems which transmit and/or receive data and/or digitized voice. The equipment comprises a transmitter and associated encoder and modulator and/or a receiver and associated demodulator and decoder.

The present document covers equipment which may use constant envelope or non-constant envelope modulation.

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

- base station: equipment fitted with antenna connector;
- mobile station: equipment fitted with antenna connector.

Handportable stations:

- a) either fitted with an antenna connector; or
- b) without an external antenna connector but fitted with a permanent internal or a temporary internal 50  $\Omega$  RF connector which allows access to the transmitter output and the receiver input.

Handportable station equipment without an external or internal Radio Frequency (RF) connector and without the possibility of having a temporary internal 50  $\Omega$  RF connector is not covered by the present document.

# 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] ANSI C63.5-2004: "American National Standard for Electromagnetic Compatibility-Radiated Emission Measurements in Electromagnetic Interference (EMI) Control-Calibration of Antennas (9 kHz to 40 GHz)".
- [2] ITU-T Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".
- [3] IEC 60489-3 (1988): "Methods of measurement for radio equipment used in the mobile services. Part 3: Receivers for A3E or F3E emissions", appendix F.
- [4] ITU-R Recommendation SM.329-10 (2003): "Unwanted emissions in the spurious domain".
- [5] ITU-T Recommendation O.41 (1994): "Psophometer for use on telephone-type circuits".

## 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] 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".
- [i.2] 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". V1.3.2:2010  
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## 3 Definitions, symbols and abbreviations

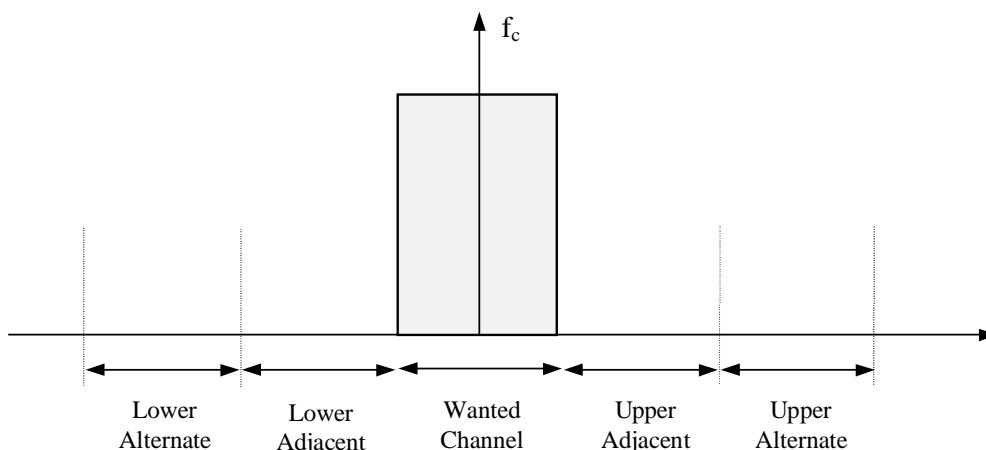
### 3.1 Definitions

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

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

**adjacent and alternate channels:**

- adjacent channels are those two channels offset from the wanted channel by the channel spacing
- 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 input socket:** socket normally intended for connection to a microphone for the purpose of voice transmission

NOTE: In some cases, this socket could be expected to be used for the input of an audio sub-carrier, modulated to carry data, such as FFSK.

**base station:** equipment fitted with an antenna connector, for use with an external antenna and intended for use in a fixed location

**bit:** binary digit

**block:** smallest quantity of information that is sent over the radio channel

NOTE: A constant number of useful bits are always sent together with the corresponding redundancy bits.

**conducted measurements:** measurements which are made using direct  $50\ \Omega$  connection to the equipment under test

**data transmission systems:** systems which transmit and/or receive data and/or digitized voice

**facilities socket:** any socket intended for purposes other than the transmission of voice

NOTE 1: The purpose of the socket and required input signals are specified by the manufacturer.

NOTE 2: The audio frequency input socket and the facilities socket may be the same physical socket in some implementations.

**handportable station:** equipment either fitted with an antenna connector or an integral antenna, or both, normally used on a stand-alone basis, to be carried on a person or held in the hand

**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

**message:** user data to be transferred in one or more packets in a session

**mobile station:** mobile equipment fitted with an antenna connector, for use with an external antenna, normally used in a vehicle or as a transportable station

**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

NOTE: See ITU-R Recommendation SM.329-10 [4].

**packet:** one block or a contiguous stream of blocks sent by one (logical) transmitter to one particular receiver or one particular group of receivers

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

**session:** set of inter-related exchange of packets occupying one or several windows or part thereof (if applicable)

NOTE: A session corresponds to a complete interactive procedure for interchanging data between users, comprising initiation, data transmission and termination procedures. The session can be short (e.g. 2 packets), or long (e.g. one full page of text).

**switching range:** maximum frequency range, as specified by the manufacturer, over which the receiver or the transmitter can be operated within the alignment range without reprogramming or realignment

**transmission (physical):** one or several packets transmitted between power on and power off of a particular transmitter

**window:** set of inter-related transmissions which may be limited in time by an appropriate access protocol and corresponding occupation rules

## 3.2 Symbols

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

AR Alignment Range

NOTE: See clause 4.1.

dB	decibel
dBm	dB relative to 1 mW
dB $\mu$ V	dB relative to 1 $\mu$ V
$f_c$	Channel centre frequency
$f_{I1}$	1 <sup>st</sup> intermediate frequency
$f_{I2}$	2 <sup>nd</sup> intermediate frequency
$f_{In}$	n <sup>th</sup> intermediate frequency
$f_{LO}$	Local oscillator frequency
M1, M2, etc.	names of test signals defined in clause 6.1
PR	rms power
PX	Maximum power
Vmin	Minimum extreme test voltage
Vmax	Maximum extreme test voltage
Tmin	Minimum extreme test temperature
Tmax	Maximum extreme test temperature
$\lambda$	wavelength

## 3.3 Abbreviations

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

ac	alternating current
Bit	Binary digit
CBW	Channel BandWidth
CSP	Channel SeParation
CTCSS	Continuous Tone Control Squelch System
CW	Continuous Wave
DC	Direct Current
EMC	ElectroMagnetic Compatibility
emf	electromotive force
EUT	Equipment Under Test
FFSK	Fast Frequency Shift Keying
GMSK	Gaussian Minimum Shift Keying

IF	Intermediate Frequency
LBT	Listen Before Transmit
OATS	Open Area Test Site
PEP	Peak Envelope Power
PMR	Professional Mobile Radio
RF	Radio Frequency
rms	root mean square
RSSI	Receiver Signal Strength Indicator
SINAD	(signal + noise + distortion)/(noise + distortion)
sr	switching range
Tx	Transmitter
VSWR	Voltage Standing Wave Ratio

## 4 General

### 4.1 Presentation of equipment for testing purposes

Each equipment to be tested submitted for testing 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.

#### 4.1.1 Choice of model for testing

The provider or manufacturer shall provide one or more samples of the equipment, as appropriate for testing.

Stand alone equipment shall be complete with any ancillary equipment needed for testing.

If an equipment has several optional features, considered not to affect the RF parameters then the tests need only to be performed on the equipment configured with that combination of features considered to be the most complex.

Where practicable, equipment to be tested shall provide a 50  $\Omega$  connector for conducted RF power level measurements.

In the case of integral antenna equipment, if the equipment does not have a internal permanent 50  $\Omega$  connector then it is permissible to supply a second sample of the equipment with a temporary antenna connector fitted to facilitate testing.

The performance of the equipment to be tested shall be representative of the performance of the corresponding production model.

##### 4.1.1.1 Auxiliary test equipment

All necessary test signal sources, setting up instructions and other product information shall accompany the equipment to be tested.

##### 4.1.1.2 Declarations by the provider

The provider or manufacturer shall declare the necessary information of the equipment with respect to all technical requirements set by the present document.

In the case of hand portable equipment without a 50  $\Omega$  external antenna connector see clause 5.6.

## 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

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#### 5.3.1 Normal temperature and humidity

SIST EN 301 166-1 V1.3.2:2010

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).