

ETSI EN 303 039 V1.1.1 (2014-04)



Harmonized European Standard

**Electromagnetic compatibility and
Radio spectrum Matters (ERM);
Land Mobile Service; Multichannel transmitter
specification for the PMR Service;
Harmonized EN covering the essential requirements
of article 3.2 of the R&TTE Directive**

PREVIEW
https://standards.etsi.org/standards-search/standards/ETSI-EN-303-039-V1-1-1-2014-04
44d1-ae9b-c87075-6222-4222-9988-054f-04

Reference

DEN/ERM-TGDMR-314

Keywords

data, mobile, PMR, radio

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Foreword

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

The present document has been produced by ETSI in response to mandate M/284 issued from the European Commission under Directive 98/34/EC [i.4] as amended by Directive 98/48/EC [i.14].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [i.3].

See article 5.1 of Directive 1999/5/EC for information on presumption of conformity and Harmonized Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

The requirements relevant to Directive 1999/5/EC [i.3] are summarized in annex A.

National transposition dates

Date of adoption of this EN:	31 March 2014
Date of latest announcement of this EN (doa):	30 June 2014
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 December 2014
Date of withdrawal of any conflicting National Standard (dow):	31 December 2015

Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive [i.3]. The modular structure is shown in EG 201 399 [i.2].

1 Scope

The present document covers the technical requirements for multiple channel radio transmitters 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 channel separations of < 10 kHz, 12,5 kHz, 20 kHz, 25 kHz, 50 kHz, 100 kHz and 150 kHz.

Table 1: Radiocommunications service frequency bands

Radiocommunications service frequency bands	
Transmit	30 MHz to 3 000 MHz

It applies to equipment for continuous and/or discontinuous transmission of data and/or digital speech and/or analogue speech and using constant envelope or non-constant envelope modulation.

The equipment comprises a transmitter capable of simultaneous amplification or transmission on two or more RF channels, or an amplifier which when operated with transmitter equipment provides simultaneous transmission on two or more RF channels. The types of equipment covered by the present document are as follows:

- base station (equipment fitted with an antenna connector, intended for use in a fixed location);
- mobile station (equipment fitted with an antenna connector, normally used in a vehicle or as a transportable);
- those hand portable stations:
 - a) fitted with an antenna connector; or
 - b) without an external antenna connector (integral antenna equipment), but fitted with a permanent internal or a temporary internal 50 Ω Radio Frequency (RF) connector which allows access to the transmitter output;
- and any equipment that may be used in combination with any of the above equipments when directly connected to those equipments for the amplification of the transmitter output signals of two or more individual equipments.

Types of equipment not covered by the present document are as follows:

- hand portable equipment without an external or internal RF connector and without the possibility of having a temporary internal 50 Ω RF connector is not covered by the present document;
- any equipment using passive combining solutions where each transmitter connected to the passive combining system transmits on a single channel, as detailed in EG 200 053 [i.13], clause H.3.

These specifications apply to the transmitter or transmitter amplifier only. If a receiver is fitted to the same equipment, the receiver specifications in the relevant specification (references [i.5] to [i.12]) should apply.

These specifications do not necessarily include all the characteristics that may be required by a user of equipment, nor do they necessarily represent the optimum performance achievable.

The present document is intended to cover the provisions of article 3.2 of Directive 1999/5/EC [i.3] (R&TTE Directive), which states that "... radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive [i.3] may apply to equipment within the scope of the present document.

NOTE: A list of such ENs is included on the web site <http://www.newapproach.org>.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

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 necessary for the application of the present document.

- [1] Recommendation ITU-T O.153 (1992): "Basic parameters for the measurement of error performance at bit rates below the primary rate".
- [2] ETSI TR 100 028 (V1.4.1) (2001) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [3] ETSI TR 102 273 (V1.2.1) (2001) (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".
- [4] 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)".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] CEPT/ERC/REC 74-01 (2011): "Unwanted Emissions in the Spurious domain".
- [i.2] ETSI EG 201 399 (V2.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the R&TTE Directive".
- [i.3] 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.4] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.
- [i.5] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".
- [i.6] ETSI EN 302 561: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using constant or non-constant envelope modulation operating in a channel bandwidth of 25 kHz, 50 kHz, 100 kHz or 150 kHz; Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive".
- [i.7] ETSI EN 300 086: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech".

- [i.8] ETSI EN 300 113: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector".
- [i.9] ETSI EN 300 296: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech".
- [i.10] ETSI EN 300 341: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service (RP 02); Radio equipment using an integral antenna transmitting signals to initiate a specific response in the receiver".
- [i.11] ETSI EN 300 390: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment intended for the transmission of data (and speech) and using an integral antenna".
- [i.12] ETSI EN 301 166: "ElectroMagnetic Compatibility and Radio spectrum Matters (ERM); Land mobile service; Technical characteristics and test conditions for radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrowband channels and having an antenna connector".
- [i.13] ETSI EG 200 053: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radio site engineering for radio equipment and systems".
- [i.14] Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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.

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

channel: width of a single frequency band which is just sufficient to ensure the transmission of all necessary information at the rate and with the quality required under specified conditions to one or more receivers

conducted measurements: measurements which are made using direct 50 Ω connection to the equipment under test

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

hand portable station: equipment either fitted with an antenna connector or 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 Ω external connector and considered to be part of the equipment

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

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

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: width of the frequency band covering the envelope of the transmitted channels, which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions for all transmitted channels

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

receive band: frequency band which is used by one or more receivers paired with the transmitter

spurious emissions: unwanted emissions in the spurious domain

switching range (sr): 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

testing laboratory: laboratory that performs tests

transmit band of the equipment: maximum frequency range (declared by the manufacturer) over which the transmitter can be operated without reprogramming or realignment

useful part of the burst: For digital modulation the period of time between the centre of the first modulation symbol and centre of the last modulation symbol of a individual transmission; for analogue modulation the period of time over which modulation is present or as defined by the power vs. time profile in figure 1.

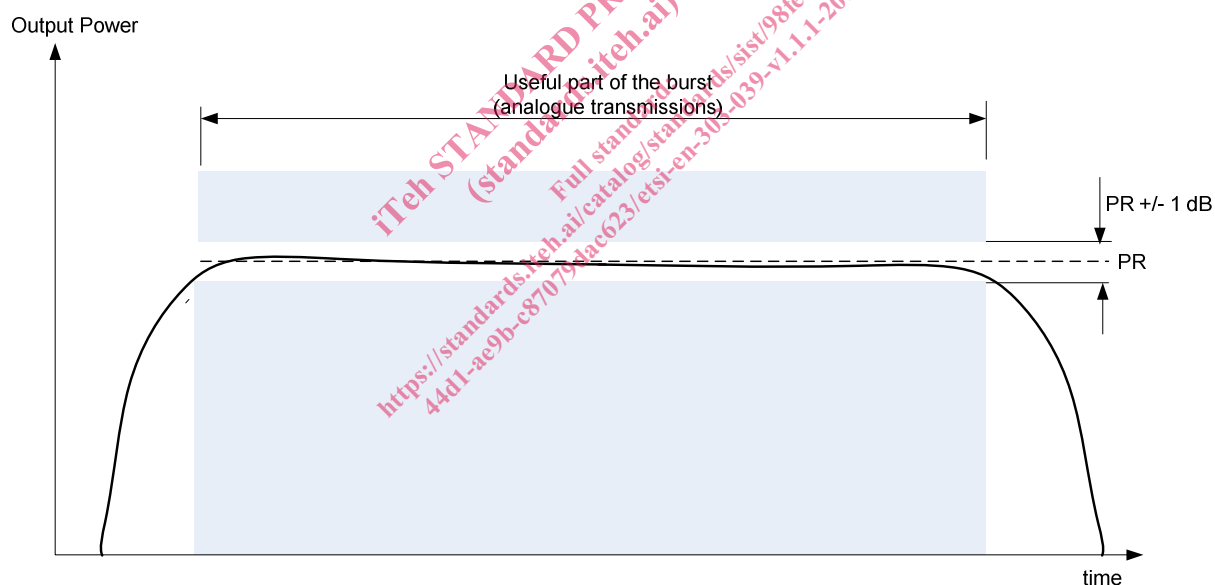


Figure 1: Useful part of the burst shown for analogue transmissions (constant envelope)

wanted bandwidth of a channel: bandwidth required for any single channel within the necessary bandwidth of the transmitter which is necessary to ensure the transmission of information at the rate and with the quality required under specified conditions for that channel only

3.2 Symbols

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

A1, A2, B1, M1, M2, etc.	names of test signals defined in clause 6.3
α	filter rolloff factor
B_{high}^1	centre frequency of out-of-band domain at higher frequency than transmitter centre frequency

B_{high}^2	highest frequency of out-of-band domain
B_{low}^1	centre frequency of out-of-band domain at lower frequency than transmitter centre frequency
B_{low}^2	lowest frequency of out-of-band domain
B_N	necessary bandwidth
BW	bandwidth of a channel
dB	decibel
dBm	dB relative to 1 mW
dB μ V	dB relative to 1 μ V
f_c	transmitter centre frequency
f_{ch}	channel centre frequency
f_{high}	highest frequency of transmitter necessary bandwidth
f_{LO}	local Oscillator frequency
f_{low}	lowest frequency of transmitter necessary bandwidth
f_{rb}	the frequency offset corresponding to the near edge of the receive band
I_i	Intermodulation product generated between two wanted channels
PR	rms power of a single channel
PRX	the value of power PR for the channel with the greatest value of PR
PX	maximum power of transmitter
T_{min}	minimum extreme test Temperature
T_{max}	maximum extreme test Temperature
V_{min}	minimum extreme test Voltage
V_{max}	maximum extreme test Voltage
λ	wavelength

3.3 Abbreviations

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

ac	alternating current
BW	BandWidth
CSP	Channel SeParation
CW	Continuous Wave
dBc	decibels relative to the transmitter power
DC	Direct Current
EUT	Equipment Under Test
GMSK	Gaussian Minimum Shift Keying
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
MBW	Measurement BandWidth
OATS	Open Area Test Site
OOB	Out-Of-Band
PEP	Peak Envelope Power
PMR	Private Mobile Radio
RF	Radio Frequency
rms	root mean square
sr	switching range
Tx	Transmitter
VSWR	Voltage Standing Wave Ratio

4 General

4.1 Presentation of equipment for testing purposes

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

The radio tests shall be performed with the centre frequency of the equipment configured in turn on the lowest, the highest and the middle radio frequency of the tunable range of the equipment. In each case, tests shall be carried out using the maximum number of channels of which the equipment is capable, with the greatest bandwidth between highest and lowest channel frequencies transmitted by the equipment (i.e. with the maximum necessary bandwidth of the equipment).

The provider or manufacturer shall declare the tunable frequency ranges, the maximum necessary bandwidth of the equipment, the minimum spacing between channels, the maximum number of channels, the modes of operation (e.g. continuous or intermittent transmission) and if transmission can be intermittent, the burst lengths and repetition frequencies and the range of operating conditions and power requirements as applicable, to establish the appropriate test conditions. The manufacturer shall also state the frequency range of the receive band intended for use with receivers paired with the equipment.

Specific parameters required for testing, such as frequency conversion oscillator frequency and tuning range, shall also be supplied.

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 the combination of features considered to be the most complex. Where practicable, equipment to be tested shall provide a 50 Ω connector for conducted RF power level measurements.

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

The test connector shall also provide any test signalling data.

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.

4.2 Multi-Mode equipment

In the case of equipment where channels can be configured to operate with more than one channel bandwidth, measurements shall be performed at least with the highest and the lowest of each channel bandwidth implemented.

Where the equipment supports different modulation types, or different modulation levels within the same type, a representative set of modulation types and levels shall be tested. At least the modulation with the highest number of modulation states per modulation symbol shall be tested.

4.3 Testing of equipment that does not have an external 50 Ω RF connector (integral antenna equipment)

Where equipment has an internal 50 Ω connector it shall be permitted to perform the tests at this connector.

Equipment may also have a temporary internal 50 Ω connector installed for the purposes of testing.

No connection shall be made to any internal permanent or temporary antenna connector during the performance of radiated emissions measurements, unless such action forms an essential part of the normal intended operation of the equipment, as declared by the manufacturer.

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 $^{\circ}\text{C}$ to +35 $^{\circ}\text{C}$;

relative humidity: 20 % to 75 %.