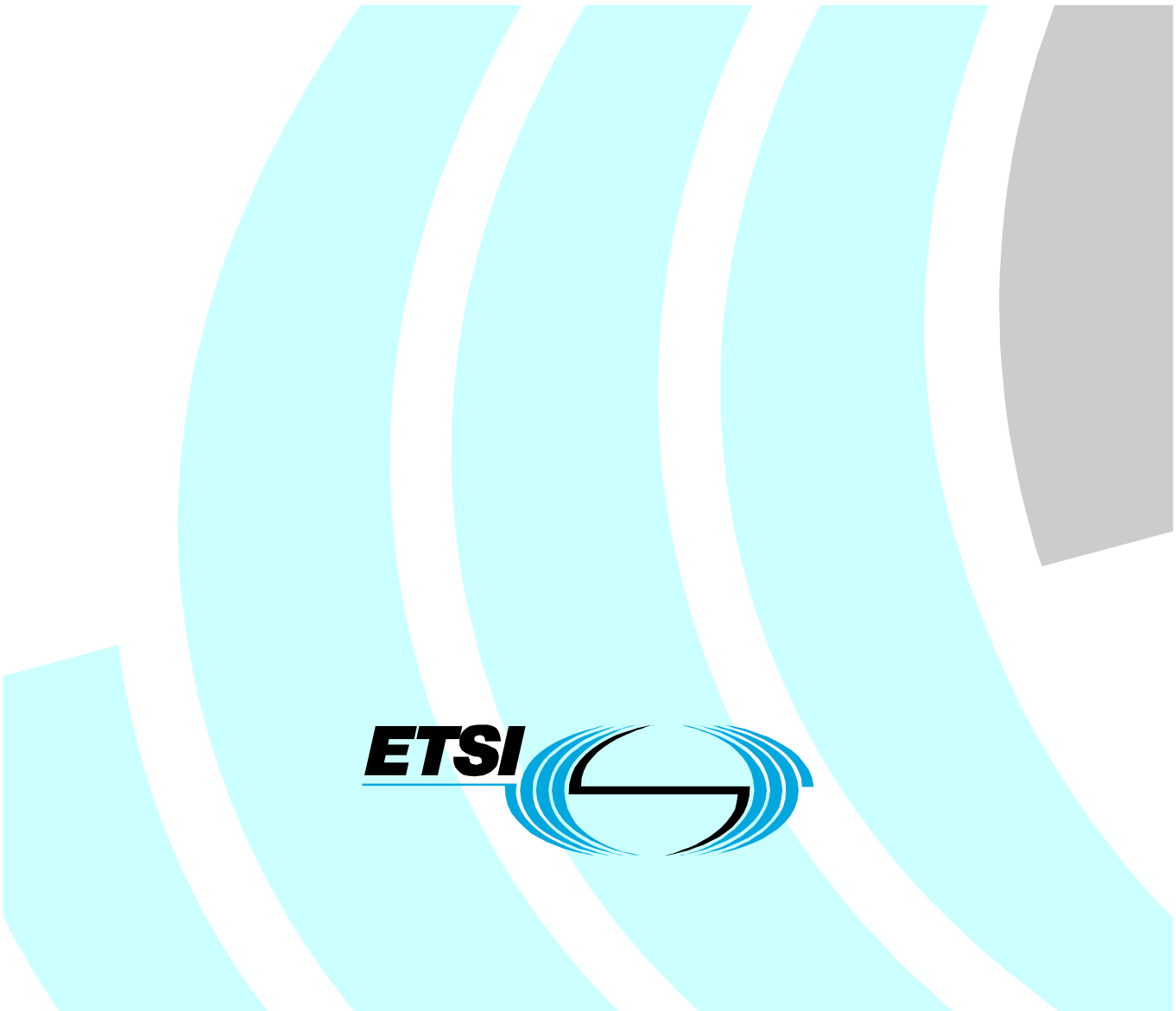
Draft ETSI EN 302 245-1 V1.1.1 (2004-05)

European Standard (Telecommunications series)

Electromagnetic compatibility and Radio spectrum Matters (ERM); Transmitting equipment for the Digital Radio Mondiale (DRM) broadcasting service; Part 1: Technical characteristics and test methods



Reference
DEN/ERM-TG17WG2-001-1

Keywords
audio, broadcasting, digital, DRM,
radio, terrestrial, transmitter

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

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 Transmitting equipment for the Digital Radio Mondiale (DRM) broadcasting service, as identified below:

Part 1: "Technical characteristics and test methods";

Part 2: "Harmonized EN 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
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

The present document covers a set of non mandatory technical parameters that are considered to be the minimum requirement for the design and operation of a DRM sound broadcasting service.

Other documents directly associated with the present document:

- EN 302 245-2 [2];
- EN 301 489-11 [3].

1 Scope

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

Transmitting equipment for the Digital Radio Mondiale (DRM) sound broadcasting service operating in the LF, MF and HF bands.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- 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.
- For a non-specific reference, the latest version applies.

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

[1] 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).

[2] ETSI EN 302 245-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Transmitting equipment for the Digital Radio Mondiale (DRM) broadcasting service Part 2: Harmonized EN under article 3.2 of the R&TTE Directive".

[3] ETSI EN 301 489-11: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 11: Specific conditions for terrestrial sound broadcasting service transmitters".

[4] ETSI TR 100 028: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

3 Definitions and abbreviations

3.1 Definitions

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

broadcasting service: radiocommunication service in which the transmissions are intended for direct reception by the general public

NOTE: This service may include sound transmissions, television transmissions or other types of transmission.

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

environmental profile: range of environmental conditions under which equipment within the scope of the present document is required to comply with the provisions of the present document

harmonic: component of order greater than 1 of the Fourier series of a periodic quantity

harmonic number: integral number given by the ratio of the frequency of a harmonic to the fundamental frequency (2^{nd} harmonic = 2 x fundamental frequency)

mean power: 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 envelope taken under normal operating conditions

multiplex: stream of all the digital data carrying one or more services within a single physical channel

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

reference bandwidth: bandwidth in which the emission level is specified

RMS power: apparent power of an AC power that is calculated by multiplying root-mean-square (rms) current by the root mean square voltage

NOTE 1: In a purely resistive circuit this is held to be the equivalent heating effect of a DC power and can be deemed to be true power. In a circuit that consists of reactance as well as resistance the apparent power is greater than the true power (the vector difference between true power and apparent power is called reactive power).

True Power = Vrms x (Irms Δ cos Ø)

Where Δ cos Ø is the phase difference between voltage and current introduced by the reactance of the load.

NOTE 2: From the above definition it becomes clear that unless any measuring system can be completely devoid of reactance then the measured power cannot be considered to be RMS power. It therefore becomes apparent that this parameter would be difficult to measure with any degree of accuracy at RF frequencies.

3.2 Abbreviations

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

AI	Amplitude Imbalance
COFDM	Coded Orthogonal Frequency Division Multiplex
dB	Decibel (tenths of a Bel)
DRM	Digital Radio Mondiale
EMC	Electro-Magnetic Compatibility
EN	European Norm
EUT	Equipment Under Test
HF	High Frequency
ITU	International Telecommunications Union
LF	Low Frequency
LV	Low Voltage
MER	Modulation Error Ratio
MF	Medium Frequency
N	Noise power
OFDM	Orthogonal Frequency Division Multiplex
QE	Quadrature Error
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RMS	Root Mean Square
s	second (unit of time)
V	Volt

4 Technical requirements specifications

4.1 Transmitter output characteristics

4.1.1 Rated output power

4.1.1.1 Definition

The rated output power is the mean power that the transmitter shall deliver at its antenna port under the manufacturers specified conditions of operation. It is, however, recommended that this parameter is not quoted as RMS power.

4.1.1.2 Method

4.1.1.2.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

1) the lowest operating frequency of the EUT;
2) the highest operating frequency of the EUT;
3) a frequency mid-way between 1) and 2) above.

Test arrangement (see figure A.1):

1) all ports unused at the time of testing shall be correctly terminated;
2) connect the EUT to the test load, via the coupling device or via the attenuator;
3) connect the measuring device to the coupling device or attenuator.

4.1.1.2.2 Procedure

The power of the signal of a DRM transmitter is defined as the long-term average of the time-varying short-term signal power. An appropriate instrument for low power DRM transmitters is a thermal power meter; for high power DRM transmitters a calorimetric method may be used.

4.1.1.2.3 Test requirements

The results obtained shall be compared to the limits in clause 4.1.1.3 in order to demonstrate compliance.

4.1.1.3 Limit

The mean output power shall be within ±10 % of the rated output power under normal operating conditions as defined by the manufacturer.

4.1.2 Frequency stability

4.1.2.1 Definition

The frequency stability of an emission is the variation of frequency against a predetermined time scale.

4.1.2.2 Method (essential test suite)

4.1.2.2.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

- any one frequency within the tuning range of the EUT.

Test arrangement (see figure A.1):

1) all ports unused at the time of testing shall be correctly terminated;

2) connect the EUT to the test load, via the coupling device or via the attenuator;

3) connect the measuring device to the coupling device or attenuator.

NOTE: Alternatively the transmitter local oscillator may be measured in order to calculate the frequency stability of the EUT RF output signal.

4.1.2.2.2 Procedure

The characteristic frequency may be measured with any suitable measuring device, provided that the accuracy attained during the measurement is better than approximately 10 % of the frequency tolerance of the frequency stability specified in clause 4.1.2.3.

For a tight frequency tolerance or a high degree of frequency stability, the measuring accuracy stated above puts higher demands on the accuracy of the measuring equipment.

Other methods of great precision use a standard reference frequency, the frequency of which is known with high accuracy. With such methods, the reception of a standard frequency transmission may be used to advantage. When the frequency is to be measured as a function of time, measurements shall be made at intervals, which are short enough to reveal the presence of superimposed periodical variations.

In this case, the measurements shall preferably be made with a recording instrument.

The accuracy of the measuring method shall be stated with the results of the measurements.

The conditions of operation shall also be given together with the assigned frequency of the emission which has been used as the characteristic frequency.

4.1.2.2.3 Test requirements

The results obtained shall be compared to the limits in clause 4.1.2.3 in order to demonstrate compliance.

4.1.2.3 Limit

For a period of not less than ninety days, the frequency of the transmitter shall stay within the tolerance of ±10 Hz.

4.1.3 Transmitter muting during frequency shift

4.1.3.1 Definition

The suppression of emissions during the re-tuning of transmitters.

4.1.3.2 Method of measurement

4.1.3.2.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

- present frequency to desired frequency.

Test arrangement (see figure A.1):

1) all ports unused at the time of testing shall be correctly terminated;
2) connect the EUT to the test load, via the coupling device;
3) connect the measuring device to the coupling device.

4.1.3.2.2 Procedure

1) operate the EUT at the present frequency;
2) initiate frequency change;
3) observe the output signal on an oscilloscope.

4.1.3.2.3 Test requirements

The results obtained shall be compared to the limits in clause 4.1.3.3 in order to demonstrate compliance.

4.1.3.3 Limit

The muting shall be as defined in table 4.1 and additionally shown in figure 4.1.

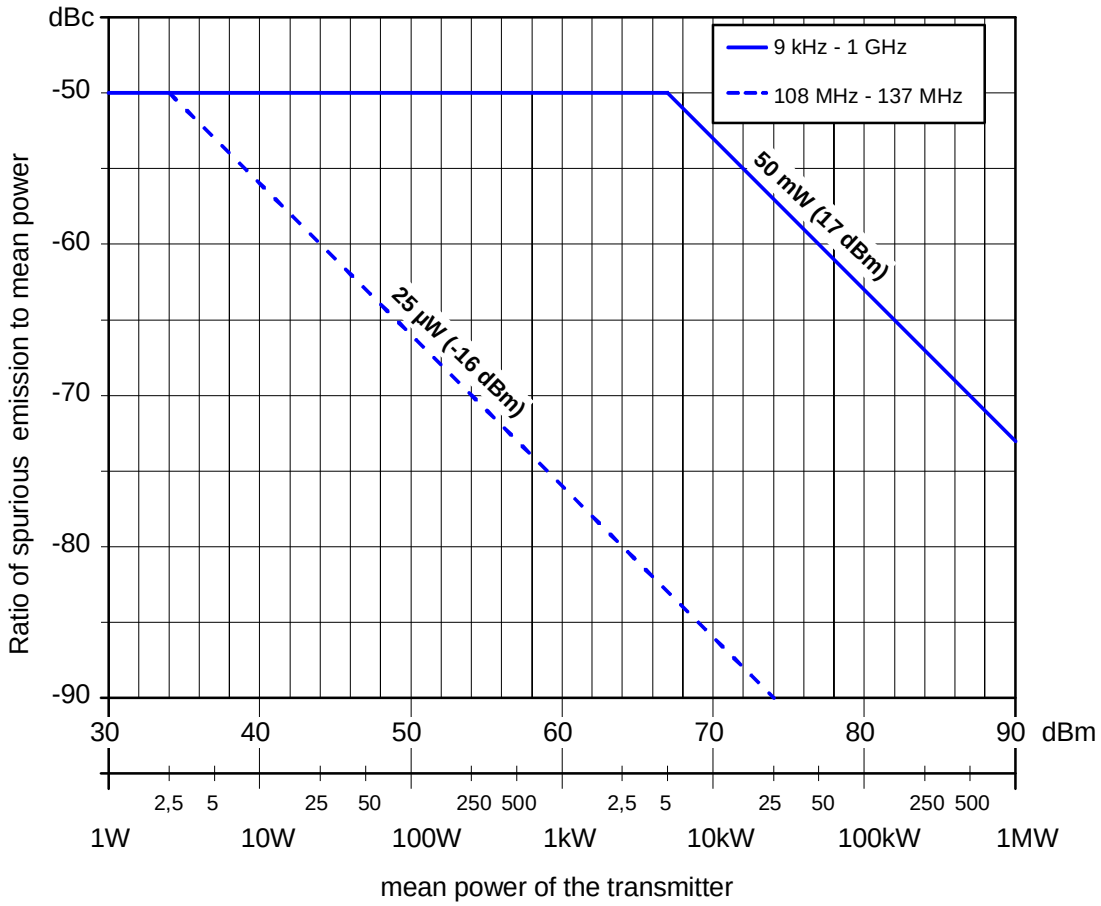


Figure 4.1: Spurious emission limits

Table 4.1: Spurious emission limits for DRM sound broadcasting transmitters

	Limits
Mean power of the transmitter	Mean power absolute levels (dBm) or relative levels (dBc) below the mean power supplied to the antenna port in the reference bandwidth (see annex A)
All power ranges	-50 dBc, without exceeding the absolute mean power of 50 mW (17 dBm)
NOTE: Within the band 108 MHz to 137 MHz the limits shall be -50 dBc, without exceeding the absolute mean power of 25 µW (-16 dBm).	

4.2 Digital signal processing

4.2.1 Modulation Error Ratio (MER)

4.2.1.1 Definition

This parameter is a single "figure of merit" analysis of the transmitted signal.

4.2.1.2 Method of measurement

The carrier frequency of the OFDM signal and the symbol timing are recovered. Origin offset of the centre carrier (e.g. caused by residual carrier or DC offset), Quadrature Error (QE) and Amplitude Imbalance (AI) are not corrected.

A time record of N received symbol co-ordinate pairs (Ij, Qj) is captured.

For each received symbol, a decision is made as to which symbol was transmitted. The error vector is defined as the distance from the ideal position of the chosen symbol (the centre of the decision box) to the actual position of the received symbol.

This distance can be expressed as a vector (δIj, δ Qj).

The sum of the squares of the magnitudes of the ideal symbol vectors is divided by the sum of the squares of the magnitudes of the symbol error vectors. The result, expressed as a power ratio in dB, is defined as the MER.

$$MER = 10 \times \log_{10} \left\{ \frac{\sum_{j=1}^{N} \left(I_j^2 + Q_j^2 \right)}{\sum_{j=1}^{N} \left(\delta I_j^2 + \delta Q_j^2 \right)} \right\} dB$$

Measurements are taken at the transmitter output using the set-up shown in figure A.1.

The measurement should be determined with the use of a receiver with the lowest possible noise factor in order to avoid causing distortion.

Operate the transmitter at its nominal output power. Measure the MER at the different modulation modes (QAM64 as well as QAM16).

Measurements are taken on all the carriers with an integration period taking into account the average value over 100 OFDM symbols.

The result will be presented in a table or graphs for the different modulation modes.

4.2.1.3 Limit

The result shall be not less than 30 dB.

4.3 Measurement uncertainties

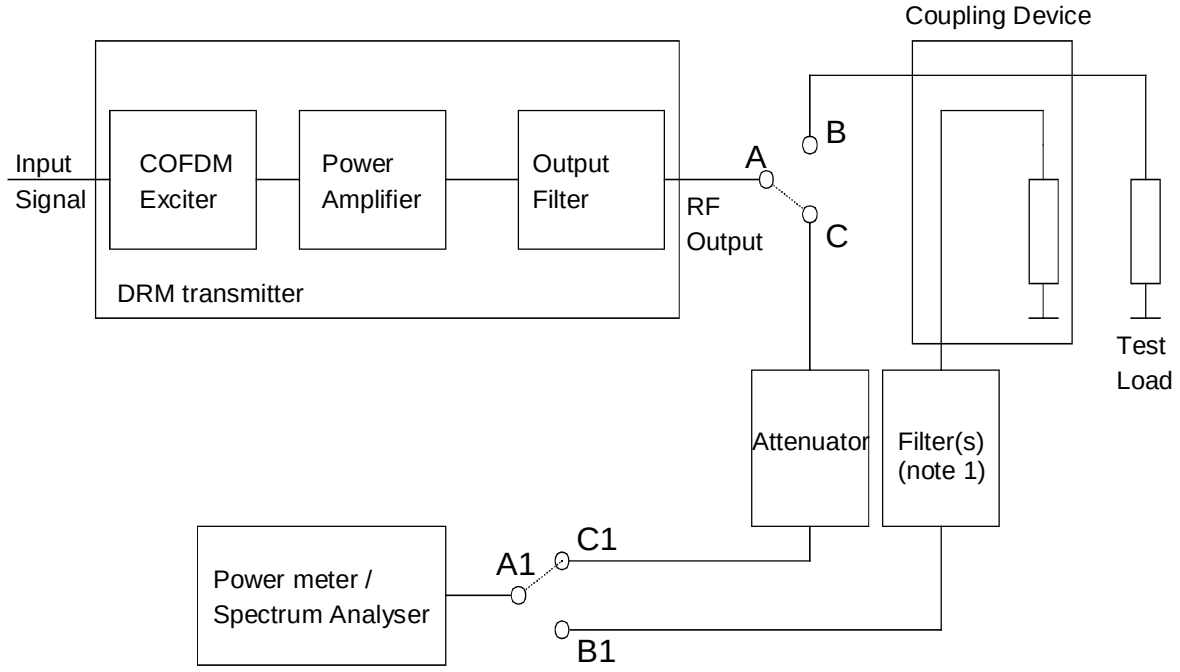
Measurement uncertainty should be calculated and techniques employed to minimize its range. This uncertainty should be applied to the limit and any measurement falling below the range is deemed acceptable [4].

Annex A (normative): Typical measuring arrangements

A.1 Testing arrangements for antenna port (and MER) measurements

The optional filter should suppress the output signal so that no intermodulation products are generated by the spectrum analyser. The insertion loss throughout the measuring range should be known.

For MER measurements substitute DRM receiver and MER measuring device for "Power meter/Spectrum Analyser".



NOTE 1: Filter(s) not used in rated output power measurements.
NOTE 2: For high power transmitters the preferred set up would require A to be connected to B and A1 to be connected to B1.
NOTE 3: For low power transmitters the preferred set up would require A to be connected to C and A1 to be connected to C1.

Figure A.1: Testing arrangement for antenna port (and MER) measurements

Annex B (normative): Test load characteristics

The transmitter may be required to operate into a precision load with return loss of >26 dB in the frequency band in which the transmitter is designed to operate.

Annex C (informative): Bibliography

CENELEC EN 60244-1: "Methods of measurement for radio transmitters; Part 1: General characteristics for broadcast transmitters".

CENELEC EN 60244-12-1: "Methods of measurement for radio transmitters; Part 12: Guideline for drawing up descriptive leaflets for transmitters and transposers for sound and television broadcasting; Characteristics to be specified".

ETSI ES 201 980: "Digital Radio Mondiale (DRM); System Specification".

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

International Telecommunication Union (ITU): "Radio regulations", Edition of 2001.

Council 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.

ITU-T Recommendation G.703 (1994): "General Aspects of Digital Transmission Equipment; Terminal Equipment. Physical/electrical Characteristics of Hierarchical Digital Interfaces".

ITU-R Recommendation V.662-3: "Terms and definitions".

History

Document history				
V1.1.1	May 2004	Public Enquiry	PE 20040910:	2004-05-12 to 2004-09-10