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**Transmitting equipment for the
Digital Radio Mondiale (DRM) service;
Harmonised Standard for access to radio spectrum**

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Foreword

This draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.4] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

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):	18 months after doa

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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1 Scope

The present document specifies technical characteristics and methods of measurements for transmitting equipment for the Digital Radio Mondiale (DRM) sound broadcasting service operating in the LF band, MF band, HF band and VHF band.

NOTE: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] is given in annex A.

2 References

2.1 Normative 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.

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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.

The following referenced documents are necessary for the application of the present document.

[1] ETSI ES 201 980 (V4.2.1) (01-2021): "Digital Radio Mondiale (DRM); System Specification".

2.2 Informative 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.

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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] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.2] Void.
- [i.3] Void.
- [i.4] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in Directive 2014/53/EU [i.1] and the following apply:

amplitude imbalance: error caused by different amplification of the I and Q signals

antenna port: port of an apparatus which is designed, in normal operation, to be connected to an antenna using coaxial cable

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.

channel bandwidth: frequency band of defined width (as a multiple of the carrier grid) including safety margin for operation on adjacent channels, located symmetrically around a carrier frequency in the carrier grid

dBc: decibels relative to the unmodulated carrier power of the emission

NOTE: In the cases which do not have a carrier, for example in some digital modulation schemes where the carrier is not accessible for measurement, the reference level equivalent to dBc is decibels relative to the mean power P.

DRM transmitter: device comprising a DRM exciter, RF amplifier and RF system filter

enclosure port: physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

NOTE: In the case of integral antenna equipment, this port is inseparable from the antenna port.

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

NOTE: Second harmonic = $2 \times$ fundamental frequency.

intermodulation products: unwanted frequencies resulting from intermodulation between carriers or harmonics of emission, or between any oscillations generated to produce the carrier

mean power: average power supplied to the antenna port 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

necessary bandwidth: 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

out-of-band emissions: emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions

quadrature error: error caused by phase shift between the I and Q signals

rated output power: mean power that the transmitter delivers at its antenna port under specified conditions of operation

reference bandwidth: bandwidth in which the emission level is specified

RF system filter: filter connected to the output of the RF amplifier to control output spectrum

NOTE: The RF system filter may be internal or external to the transmitter casing.

spurious emissions: emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

NOTE: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

unwanted emissions: spurious emissions and out-of-band emissions

3.2 Symbols

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

Hz	Hertz (cycles per second)
μ	micro, 10^{-6}
V	Volt
W	Watt

3.3 Abbreviations

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

DC	Direct Current
DRM	Digital Radio Mondiale
EFTA	European Free Trade Association
EN	European Norm
EUT	Equipment Under Test
HF	High Frequency
I	In-phase component of a signal
LF	Low Frequency
MER	Modulation Error Ratio
MF	Medium Frequency
N	Noise power
OFDM	Orthogonal Frequency Division Multiplex
Q	Quadrature phase component of a signal
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
VHF	Very High Frequency

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be in accordance with its intended use. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

4.2 Conformance requirements

4.2.1 Rated output power

4.2.1.1 Definition

The rated output power is the mean power that the transmitter shall deliver at its antenna port.

4.2.1.2 Limit

The mean output power shall be within -0,5 dB of the rated output power under normal operating conditions as defined by the manufacturer.

4.2.1.3 Conformance

Conformance tests as defined in clause 5.3.1 shall be carried out.

4.2.2 Frequency stability

4.2.2.1 Definition

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

4.2.2.2 Limit

4.2.2.2.1 DRM transmitters operating below 30 MHz

The stability of the centre frequency shall not deviate more than 10 Hz from its nominal value.

4.2.2.2.2 DRM transmitters operating between 30 MHz and 300 MHz

The stability of the centre frequency shall not deviate more than 100 Hz from its nominal value.

4.2.2.3 Conformance

Conformance tests as defined in clause 5.3.2 shall be carried out.

4.2.3 Spurious emissions

4.2.3.1 Definition

Emission on a frequency or on frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

For the purposes of the present document spurious emissions are emissions at frequencies outside 500 % of the necessary bandwidth.

The reference bandwidth used for spurious emissions measurements shall be as follows:

- 1 kHz between 9 kHz and 150 kHz;
- 10 kHz between 150 kHz and 30 MHz;
- 100 kHz between 30 MHz and 1 GHz;
- 1 MHz above 1 GHz.

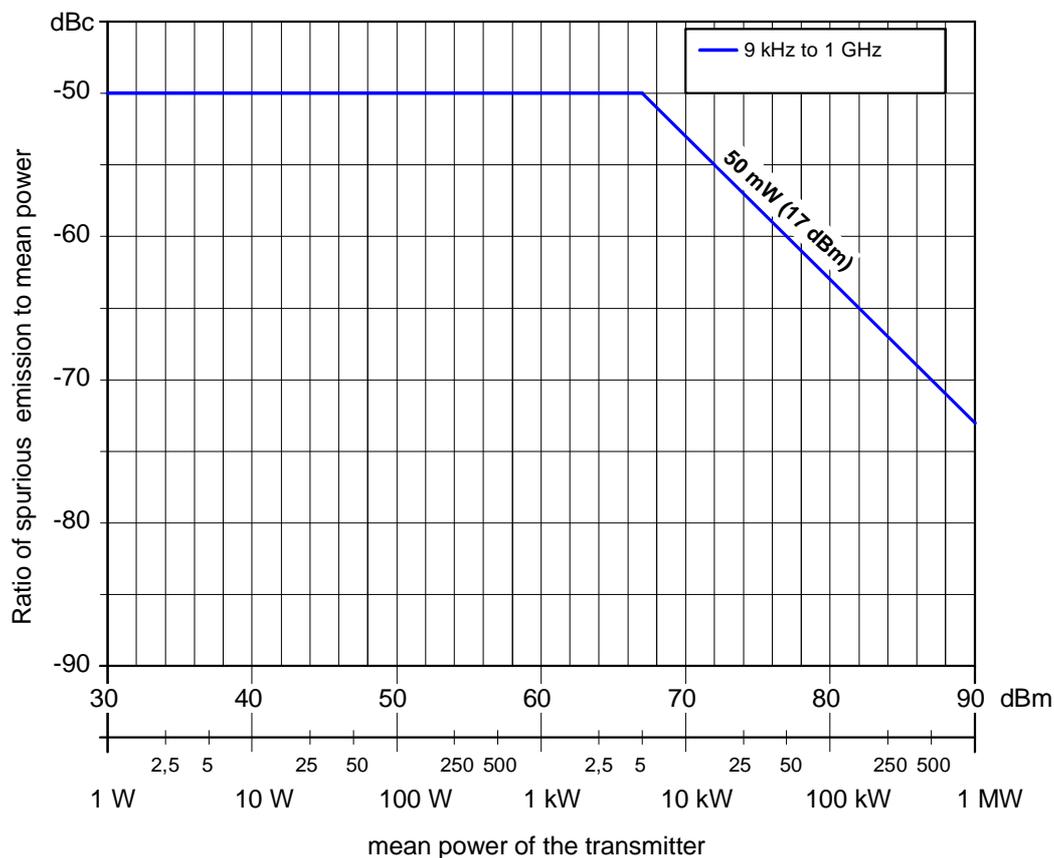
4.2.3.2 Limit

4.2.3.2.1 DRM transmitters operating below 30 MHz

Spurious emissions shall not exceed the values set out in table 1 and additionally as shown in figure 1 for the frequency range 9 kHz to 1 GHz.

Table 1: Spurious emission limits for DRM transmitters operating below 30 MHz

Mean power of the transmitter	Limits Mean power absolute levels (dBm) or relative levels (dBc) below the mean power supplied to the antenna port in the reference bandwidth (see clause 4.2.3.1)
All power ranges	-50 dBc, without exceeding the absolute mean power of 50 mW (17 dBm)

**Figure 1: Spurious emission limits for DRM transmitters operating below 30 MHz**

4.2.3.2.2 DRM transmitters operating between 30 MHz and 300 MHz

For DRM transmitters operating between 30 MHz and 300 MHz, spurious emissions shall not exceed the values set out in table 2 and additionally as shown in figure 2 for the frequency range 9 kHz to 3 GHz.

Table 2: Spurious emission limits for DRM transmitters operating between 30 MHz and 300 MHz

Mean power of the transmitter	Limits Mean power absolute levels (dBm) or relative levels (dBc) below the power supplied to the antenna port in the reference bandwidth (see clause 4.2.3.1)
$P < 9$ dBW	-36 dBm
9 dBW $\leq P < 29$ dBW	75 dBc
29 dBW $\leq P < 39$ dBW	-16 dBm
39 dBW $\leq P < 50$ dBW	85 dBc
50 dBW $\leq P$	-5 dBm

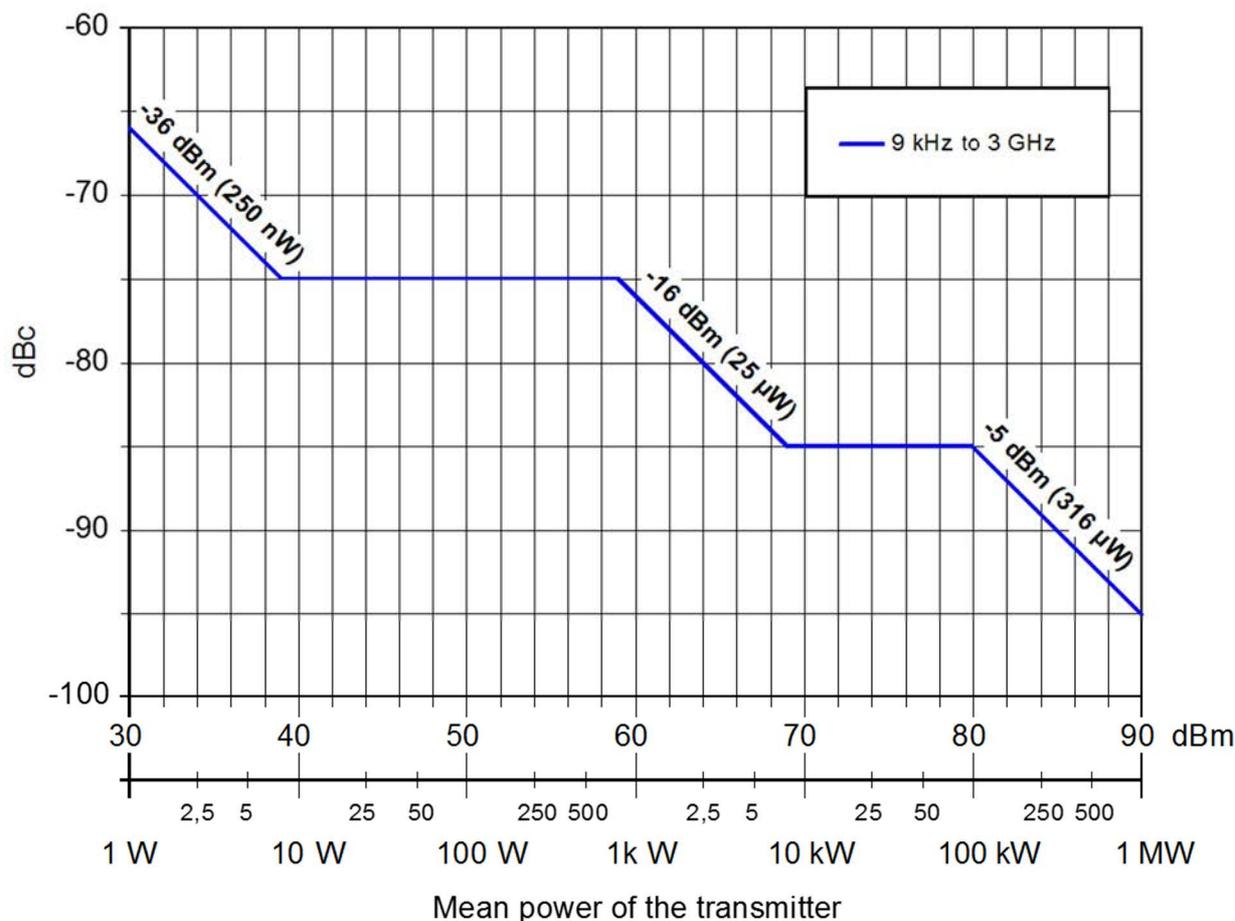


Figure 2: Spurious emission limits for DRM transmitters operating between 30 MHz and 300 MHz

4.2.3.3 Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out.

4.2.4 Transmitter muting during frequency shift

4.2.4.1 Definition

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

4.2.4.2 Limits

The limits defined in clause 4.2.3.2 shall apply.

4.2.4.3 Conformance

Conformance tests as defined in clause 5.3.4 shall be carried out.

4.2.5 Out-of-band emissions

4.2.5.1 Definition

Out-of-band emissions are defined as any emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

For the purposes of the present document the out-of-band region shall extend to $\pm 500\%$ of the necessary bandwidth.

4.2.5.2 Limit

4.2.5.2.1 DRM transmitters operating below 30 MHz

Out of band emissions shall not exceed the values set out in table 3. Additionally, the limits are shown in figure 3 on a logarithmic frequency axis and in figure 4 on a linear axis. The reference bandwidth used for out-of-band emissions measurements shall be 100 Hz.

Table 3: Out-of-band emission limits for DRM transmitters operating below 30 MHz

Relative Frequency (f/F)	Frequency difference (f) from the centre frequency at different channel bandwidths (F) (kHz)				Relative level (dB)
	F = 4,5	F = 5	F = 9	F = 10	
±0,1	0,45	0,5	0,9	1	0
±0,5	2,25	2,5	4,5	5	0
±0,7	3,15	3,50	6,3	7	-35
±1,4	6,3	7	12,6	14	-47
±2,8	12,6	14	25,2	28	-59
≥ ±2,952	13,28	14,76	26,57	29,52	-60

NOTE: Figure 3 is only an additional representation of the limits given in table 3. It is not representative of the output of a spectrum analyser. The slope outside $\pm 0,7 \times F$ is 12 dB per octave until the value of -60 dB is reached.

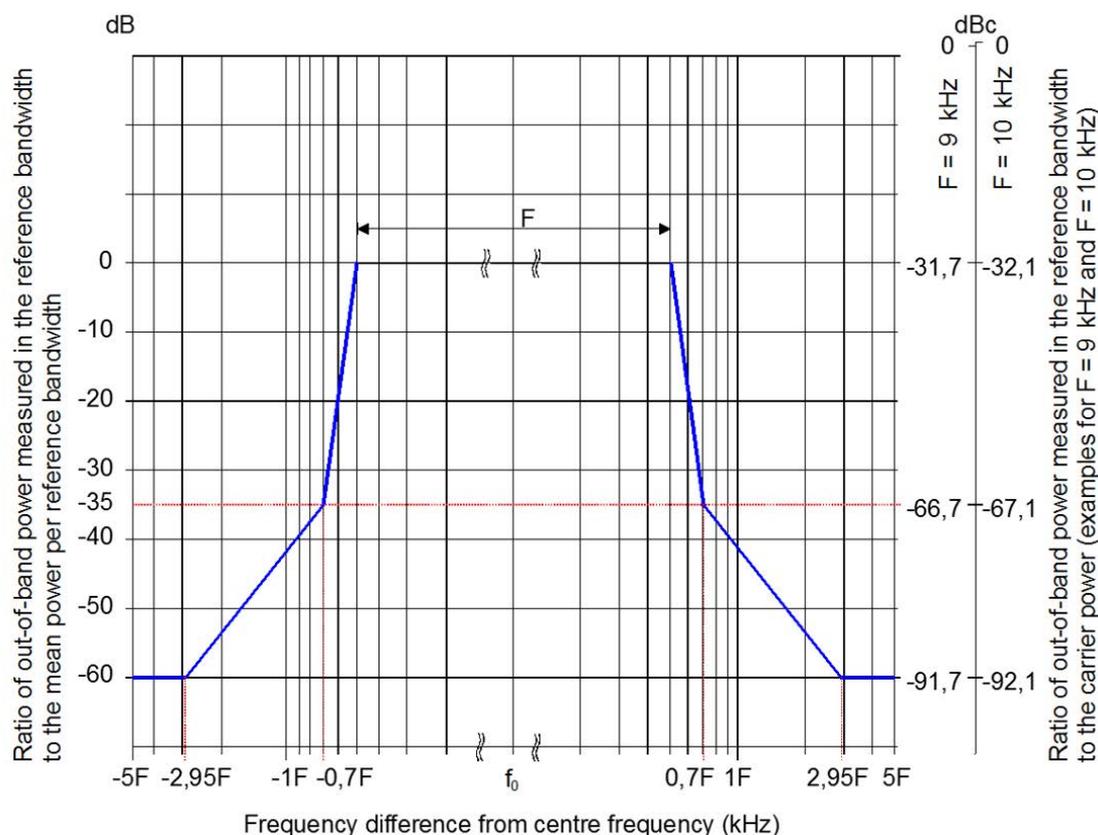


Figure 3: Out of band emission limits for DRM transmitters operating below 30 MHz shown on a logarithmic axis

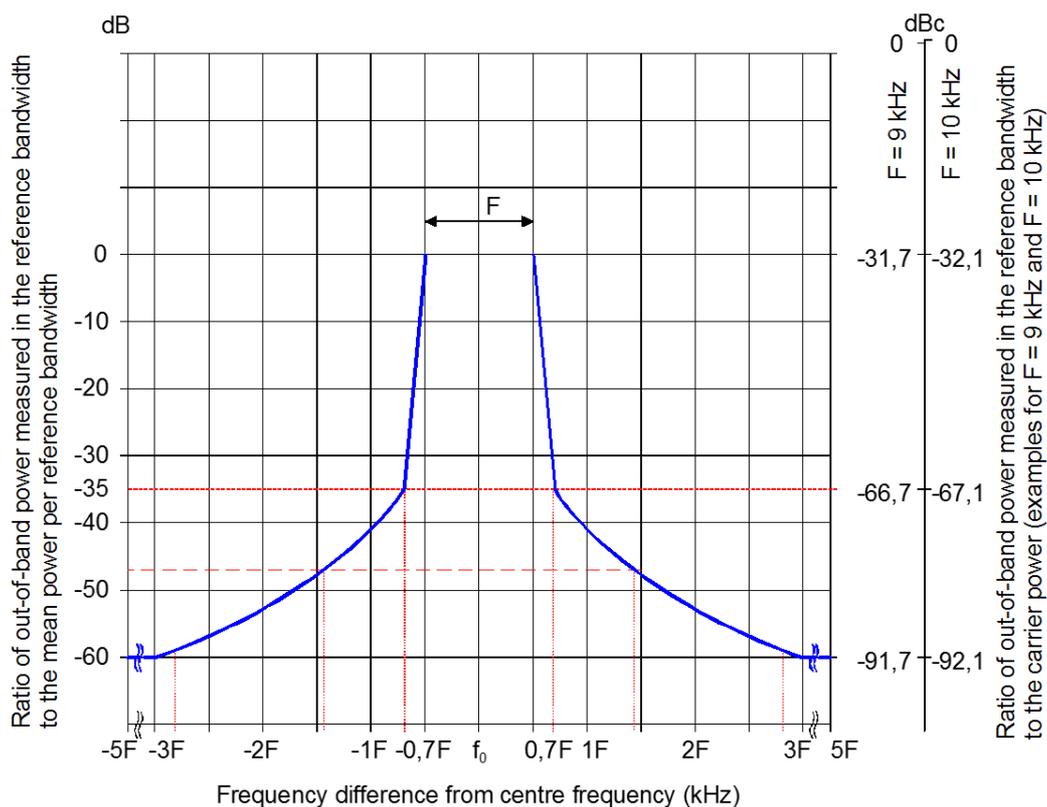


Figure 4: Out of band emission limits for DRM transmitters operating below 30 MHz shown on a linear axis

4.2.5.2.2 DRM transmitters operating between 30 MHz and 300 MHz

Out of band emissions shall not exceed the values set out in table 4 and additionally as shown in figure 5. The reference bandwidth used for out-of-band emissions measurements shall be 1 kHz.

Table 4: Break points of spectrum limit mask for DRM transmitters operating between 30 MHz and 300 MHz

Frequency relative to the centre of the channel (kHz)	Relative level (dBc)
-500	-65
-300	-65
-200	-60
-100	-50
-70	-30
-50	0
50	0
70	-30
100	-50
200	-60
300	-65
500	-65

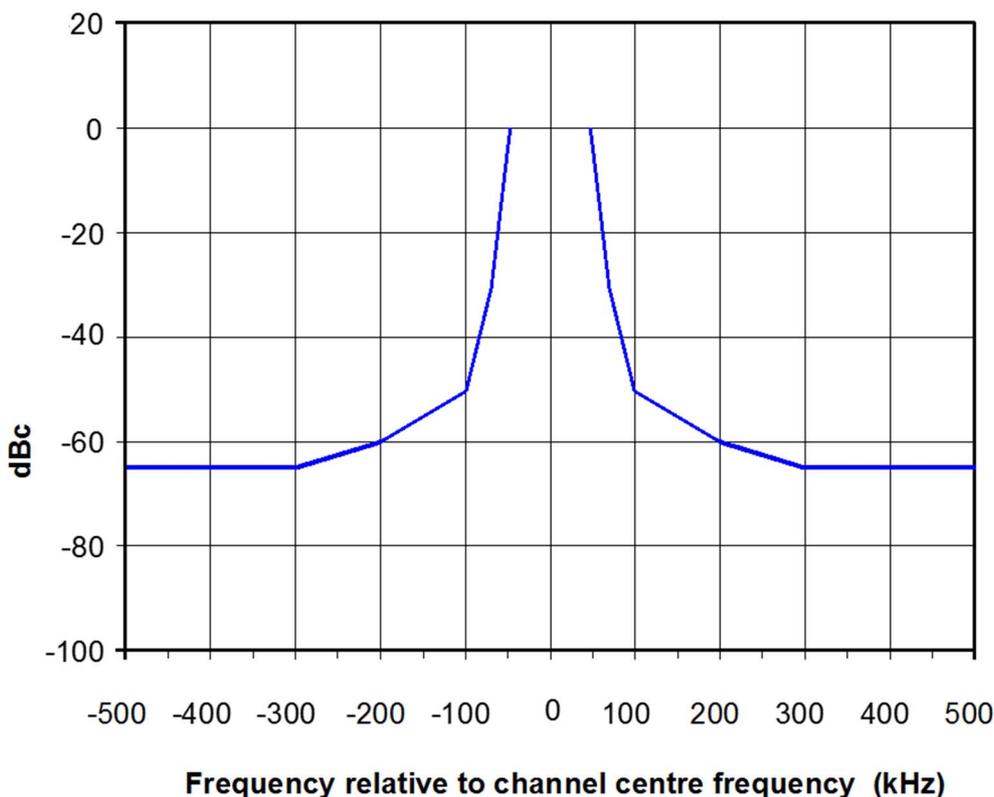


Figure 5: Out-of-band emission limits for DRM transmitters operating between 30 MHz and 300 MHz

4.2.5.3 Conformance

Conformance tests as defined in clause 5.3.5 shall be carried out.

4.2.6 Modulation Error Ratio (MER)

4.2.6.1 Definition

MER is a single parameter to measure the quality of the transmitted signal. It is defined as the sum of the squares of the magnitudes of the ideal symbol vectors divided by the sum of the squares of the magnitudes of the symbol error vectors. The result is expressed as a power ratio in dB.

The carrier frequency of the OFDM signal and the symbol timing are recovered by the receiver. In the received signal origin offset (e.g. caused by residual carrier or DC offset in the mixers), quadrature error (e.g. caused by phase shift between the I and Q signal) and amplitude imbalance (e.g. caused by different amplification of I and Q) are not corrected in the receiver.

A time record of N received symbol co-ordinate pairs (I_j, Q_j) 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 $(\delta I_j, \delta Q_j)$.

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

4.2.6.2 Limit

4.2.6.2.1 DRM transmitters operating below 30 MHz

The result shall be not less than 30 dB.

4.2.6.2.2 DRM transmitters operating between 30 MHz and 300 MHz

The result shall be not less than 21 dB.

4.2.6.3 Conformance

Conformance tests as defined in clause 5.3.6 shall be carried out.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the operational environmental profile defined by its intended use.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the operational environmental profile defined by its intended use) to give confidence of compliance for the affected technical requirements.

5.2 Test modulating signal

An input signal shall be provided, according to the specification of the transmitter, to obtain a valid DRM output signal as defined in ETSI ES 201 980 [1], clause 8.

5.3 Methods of measurement

5.3.1 Rated output power

5.3.1.1 Initial conditions

Test frequencies:

- a) the lowest operating frequency of the EUT;
- b) the highest operating frequency of the EUT;
- c) a frequency mid-way between a) and b) above.

Test arrangement (see figure B.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 spectrum analyser or power meter to the coupling device or attenuator.

5.3.1.2 Procedure

- 1) operate the EUT at each of the test frequencies as defined in clause 5.3.1.1;
- 2) measure the results on the spectrum analyser or power meter.

An appropriate instrument for low power DRM transmitters is a thermal power meter; for high power DRM transmitters a calorimetric method may be used.

5.3.1.3 Test requirements

The results obtained shall be compared to the limits in clause 4.2.1.2 in order to demonstrate compliance.

5.3.2 Frequency stability

5.3.2.1 Initial conditions

Test frequency:

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

Test arrangement (see figure B.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.

5.3.2.2 Procedure

- 1) operate the exciter of the EUT at the test frequency as defined in clause 5.3.2.1;
- 2) measure the maximum deviation on the frequency recorder over a 5 minute period.

5.3.2.3 Test requirements

The results obtained shall be compared to the limits in clause 4.2.2.2 in order to demonstrate compliance.

5.3.3 Spurious emissions

5.3.3.1 Initial conditions

Test frequencies:

- a) the lowest operating frequency of the EUT;
- b) the highest operating frequency of the EUT;
- c) a frequency mid-way between a) and b) above.

Test arrangement (see figure B.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 (a filter may be used to attenuate the wanted signal).

5.3.3.2 Procedure

- 1) operate the EUT at each of the test frequencies as defined in clause 5.3.3.1 at its nominal power;
- 2) measure the results on the spectrum analyser.

5.3.3.3 Test requirements

The results obtained shall be compared to the limits in clause 4.2.3.2 in order to demonstrate compliance.

5.3.4 Transmitter muting during frequency shift

5.3.4.1 Initial conditions

Test frequencies:

- a) the lowest operating frequency of the EUT;
- b) the highest operating frequency of the EUT.

Test arrangement (see figure B.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 spectrum analyser to the coupling device;
- 4) set reference bandwidth as per clause 4.2.3.1;
- 5) set span to correspond to the tuneable frequency range between points "a" and "b";
- 6) set the sweep time of the spectrum analyser to be not greater than 1/10 of the frequency switching period of the EUT;
- 7) set the spectrum analyser to "MAX HOLD".

NOTE: If it is not possible to attain the necessary dynamic range in the Spectrum Analyser, the measuring range can be split into several parts.

5.3.4.2 Procedure

- 1) operate the EUT at the frequency as defined in clause 5.3.4.1 point "a";
- 2) initiate frequency change to frequency defined in clause 5.3.4.1 point "b";
- 3) retune the EUT five times between points "a" and "b".

5.3.4.3 Test requirements

The results obtained shall be compared to the limits in clause 4.2.4.2 in order to demonstrate compliance.

5.3.5 Out-of-band emissions

5.3.5.1 Initial conditions

Test environment:

- representative points within the boundary limits of the declared operational environmental profile.

Test frequencies:

- a) the lowest operating frequency of the EUT;
- b) the highest operating frequency of the EUT;
- c) a frequency mid-way between a) and b) above.

Test arrangement (see figure B.1).

5.3.5.2 Procedure

- 1) all ports unused at the time of testing shall be correctly terminated;
- 2) operate the EUT at each of the test frequencies as defined in clause 5.3.5.1 at its nominal power;
- 3) measure the results on the Spectrum Analyser.

5.3.5.3 Test requirements

The results obtained shall be compared to the limits in clause 4.2.5.2 in order to demonstrate compliance.

5.3.6 Modulation Error Ratio (MER)

5.3.6.1 Initial conditions

Test environment:

- precisely the same transmitter optimization settings used for the out-of-band emissions test, see clause 5.3.5.

NOTE: This is to ensure that the MER requirement is met whilst the transmitter is operating within the spectrum mask.

Test frequencies:

- a) the lowest operating frequency of the EUT;
- b) the highest operating frequency of the EUT;
- c) a frequency mid-way between a) and b) above.

Test arrangement (see figure B.1).

- 1) connect the EUT to the Test Load, via the Coupling Device;
- 2) connect a measuring receiver to the Coupling Device.

The measurement should be determined with the use of a receiver with the lowest possible noise factor in order to avoid causing measurement error. This receiver should be able to demodulate a clean DRM signal and should have a MER, that is at least 10 dB higher than the limit stated in clause 4.2.6.2.

5.3.6.2 Procedure

- 1) all ports unused at the time of testing shall be correctly terminated;
- 2) operate the EUT at the test frequencies defined in clause 5.3.6.1 at its nominal power;
- 3) measure the MER for the different modulation modes (64 QAM, 16 QAM, 4 QAM as appropriate).

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

5.3.6.3 Test requirements

The results obtained shall be compared to the limits in clause 4.2.6.2 in order to demonstrate compliance.

Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.4] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table A.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 302 245					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Rated output power	3.2	4.2.1	U	
2	Frequency stability	3.2	4.2.2	U	
3	Spurious emissions	3.2	4.2.3	U	
4	Transmitter muting during frequency shift	3.2	4.2.4	C	Transmitters that allow frequency shift as an operational mode
5	Out-of-band emissions	3.2	4.2.5	U	
6	MER	3.2	4.2.6	U	

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

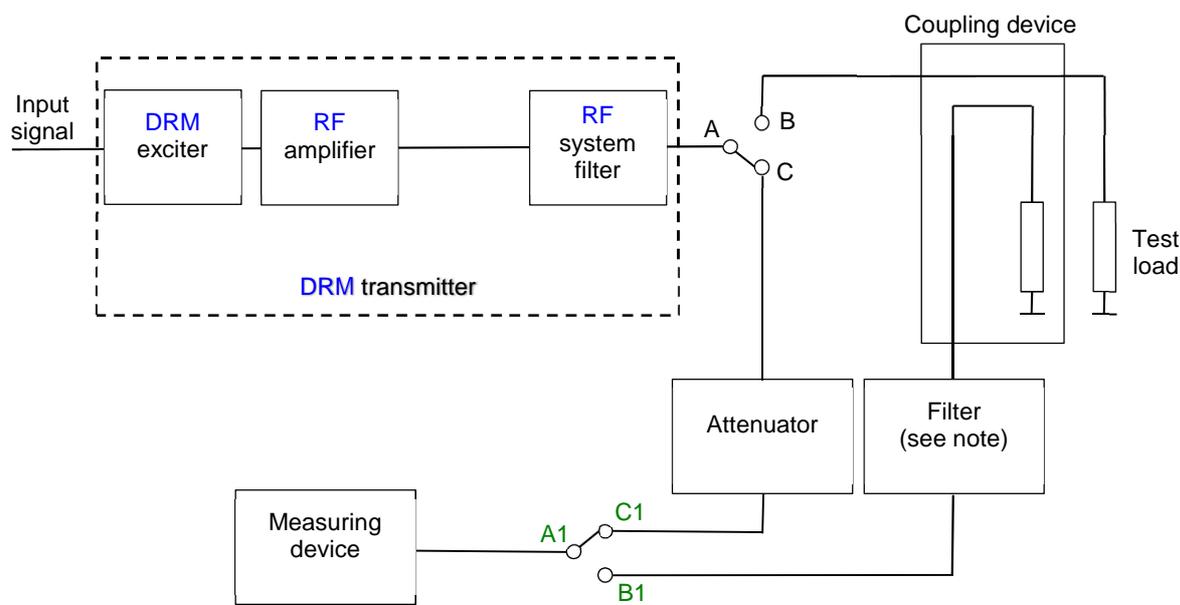
Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (normative): Measuring arrangements

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



For high power transmitters the preferred set up requires A to be connected to B and A1 to be connected to B1. For low power transmitters the preferred set up requires A to be connected to C and A1 to be connected to C1.

NOTE: The filter shall suppress the output signal so that no intermodulation products are generated by the measuring device. The insertion loss throughout the measuring range shall be known.

Figure B.1: Testing arrangement for antenna port measurements

B.2 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): Maximum measurement uncertainty

The measurements described in the present document are based on the following assumptions:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter is included in the test report.

Table C.1 shows the recommended values for the maximum measurement uncertainty figures.

Table C.1: Maximum measurement uncertainty

Parameter	Uncertainty
Rated power output (conducted)	0,75 dB
Frequency drift	0,1 Hz
Spurious emissions (conducted emissions)	3,0 dB
Transmitter muting during frequency shift (conducted emissions)	3,0 dB
Out-of-band emissions (conducted emissions)	3,0 dB
Modulation Error Ratio	0,75 dB

Annex D (informative): Change history

Version	Information about changes
2.1.1	First published version covering Directive 2014/53/EU. Major changes are: <ul style="list-style-type: none"><li data-bbox="421 427 1319 450">• Addition of provisions for transmitters operating between 30 MHz and 300 MHz.
2.2.1	Second published version covering Directive 2014/53/EU. Minor changes are: <ul style="list-style-type: none"><li data-bbox="421 517 1319 539">• Revision of parts of clause 5.3 to provide greater clarity of procedures.

History

Document history		
V1.1.1	January 2005	Publication as ETSI EN 302 245 parts 1 and 2
V2.1.1	June 2018	Publication
V2.2.0	February 2022	EN Approval Procedure AP 20220517: 2022-02-16 to 2022-05-17