

ETSI EN 303 345-5 V1.2.1 (2021-12)



**Broadcast Sound Receivers;
Part 5: DRM broadcast sound service;
Harmonised Standard for access to radio spectrum**

ReferenceREN/ERM-TG17-159

Keywordsbroadcast, digital, harmonised standard, radio,
receiver

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Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] 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.

The present document is part 5 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

The present document has a number of test data files that are contained in archive en_30334501v010101p0.zip which accompanies ETSI EN 303 345-1 [1].

National transposition dates	
Date of adoption of this EN:	21 December 2021
Date of latest announcement of this EN (doa):	31 March 2022
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 September 2022
Date of withdrawal of any conflicting National Standard (dow):	30 September 2023

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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Introduction

The present document provides the necessary limits and conformance requirements for radio receivers to meet the essential requirements of article 3.2 of Directive 2014/53/EU [i.1] for the DRM sound broadcast service and is used with reference to ETSI EN 303 345-1 [1], which describes the generic requirements and test methods.

1 Scope

The present document specifies technical characteristics and methods of measurements for broadcast sound receivers with DRM demodulation.

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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://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.

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

- [1] ETSI EN 303 345-1 (V1.1.1) (06-2019): "Broadcast Sound Receivers; Part 1: Generic requirements and measuring methods".
- [2] ETSI ES 201 980 (V4.1.1) (01-2014): "Digital Radio Mondiale (DRM); System Specification".
- [3] EN 55032:2015: "Electromagnetic compatibility of multimedia equipment - Emission Requirements", produced by CENELEC.

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] 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.
- [i.3] Void.
- [i.4] Void.
- [i.5] AES17: "AES standard method for digital audio engineering - Measurement of digital audio equipment".

- [i.6] ETSI EG 203 336 (V1.1.1) (08-2015): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".
- [i.7] ITU GE75: "Final Acts of the Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3)".
- [i.8] ITU GE84: "Final Acts of the Regional Administrative Radio Conference for the Planning of the VHF Sound Broadcasting (Region 1 and part of Region 3)".
- [i.9] ITU GE06: "Final Acts RRC-06".
- [i.10] Recommendation ITU-R BS.1615-1 (05/2011): "'Planning parameters' for digital sound broadcasting at frequencies below 30 MHz".
- [i.11] Recommendation ITU-R BS.1660-7 (10/2015): "Technical basis for planning of terrestrial digital sound broadcasting in the VHF band".
- [i.12] Recommendation ITU-R SM.332-4 (07/1978): "Selectivity of Receivers".

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:

built-in antenna: antenna that cannot be detached from the equipment

integral antenna: antenna which is detachable from the equipment without the use of any tools, and not using a 50 Ω or 75 Ω external connector

NOTE: A device that uses a supplied earphone as the antenna has an integral antenna.

3.2 Symbols

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

dBFS	decibels relative to Full Scale in accordance with AES17 [i.5]
dBm	decibels relative to 1 mW of power
dB μ V/m	decibels relative to 1 μ V/m

3.3 Abbreviations

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

AAC	Advanced Audio Coding
ACS	Adjacent Channel Selectivity
ADC	Analogue to Digital Converter
AM	Amplitude Modulation
DDC	Direct Digital Conversion
DRM	Digital Radio Mondiale
EFTA	European Free Trade Association
EU	European Union
HF	High Frequency
ITU-R	International Telecommunications Union - Radiocommunications sector
LF	Low Frequency
LO	Local Oscillator
MF	Medium Frequency
MSC	Main Service Channel

NZIF	Near-Zero Intermediate Frequency
OFDM	Orthogonal Frequency Division Modulation
RED	Radio Equipment Directive
RF	Radio Frequency
RM	Robustness Mode
VHF	Very High Frequency

4 Technical requirements specifications

4.1 Test signal configurations

The generated DRM signals (wanted and unwanted) and the blocking signal shall be in accordance in table 1.

Table 1: DRM configuration

Parameter	DRM signals						AM signal
	Wanted			Unwanted			Blocking
Audio coding	Service label: "Sine 1 kHz" 1 kHz tone at a level of -3 dBFS Coding: mono AAC at maximum permitted rate			Service label: "Sine 2 kHz" 2 kHz tone at a level of -3 dBFS Coding: mono AAC at maximum permitted rate			1 kHz tone
Frequency band	LF/MF	HF	VHF	LF/MF	HF	VHF	
Channel coding parameters	RM flag	0	0	1	0	0	1
	protection level	1	1	2	1	1	2
	MSC mode	0	0	0	0	0	0
	interleaver depth	1	1	0	1	1	0
	robustness mode	B	B	E	B	B	E
spectrum occupancy	2	3	0	2	3	0	
Other modulation Parameters	DRM signal to ETSI ES 201 980 [2], clause 8			DRM signal to ETSI ES 201 980 [2], clause 8			80 % depth

NOTE: Level is defined in accordance with AES17 [i.5].

An arbitrary waveform file producing the blocking signal is available in archive en_30334501v010101p0.zip which accompanies ETSI EN 303 345-1 [1].

4.2 Sensitivity

4.2.1 Definition

The receiver sensitivity is the minimum wanted signal level required to provide a given level of audio quality.

4.2.2 Limits

The limits for sensitivity specified in table 2 shall apply. Each figure quoted is the required level of wanted signal which provides a given level of audio quality. The audio impairment criteria relevant for these tests is clean audio: that is 10 seconds of audio without impairments (e.g. no muting, clicks, warbles or squeaks).

Table 2: DRM sensitivity limits

De-modulation	Tuned frequency band	Wanted signal centre frequency (MHz)	Required sensitivity limit	
			Conducted (dBm)	Radiated (dB μ V/m)
DRM	LF	0,216	-99	58
	MF	0,999	-99	52
	HF1	4	-99	44
	HF2	19	-99	40
	VHF band I	65	-100	45
	VHF band II	100	-100	46
	VHF band III	200	-100	51

4.2.3 Conformance

Conformance tests as defined in ETSI EN 303 345-1 [1], clause 5.3.4.2 shall be carried out for each DRM band provided by the receiver. The wanted signal generator shall be set to produce a signal according to table 1 at the centre frequency according to table 2. The required sensitivity level shall be as indicated in table 2. If the impairment criterion given in clause 4.2.2 is met then the receiver has passed the sensitivity requirement.

4.3 Adjacent channel selectivity and blocking

4.3.1 Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation. The wanted and unwanted signals are of the same modulation type.

The blocking ratio at a given frequency separation, is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal.

In order to provide effective use of spectrum, devices shall be able to demodulate the tuned signal in the presence of similar signals in adjacent channels. In addition, testing shall also be performed to check the ability of the receiver to work effectively with interfering signals at a greater separation from the wanted signal (blocking).

The channel spacings specified in table 3 shall apply.

Table 3: Channel spacing for adjacent channel selectivity and blocking

Demodulation	Tuned frequency band	Unwanted frequency (N = 1, 2, 3)	Unwanted frequency (blocking)
DRM	LF	$\pm N \times 9$ kHz	± 90 kHz
	MF	$\pm N \times 9$ kHz	± 90 kHz
	HF	$\pm N \times 10$ kHz	± 100 kHz
	VHF band I	$\pm N \times 100$ kHz	± 800 kHz
	VHF band II	$\pm N \times 100$ kHz	± 800 kHz
	VHF band III	$\pm N \times 100$ kHz	± 800 kHz

4.3.2 Limits

The limits for selectivity and blocking specified in table 4 shall apply with the channel spacings given in table 3. Each figure quoted is the minimum acceptable level of unwanted signal, relative to that of the wanted signal, which provides a given level of audio quality. The audio impairment criterion relevant for these tests is clean audio: that is 10 seconds of audio without impairments (e.g. no muting, clicks, warbles or squeaks).

Table 4: Adjacent channel selectivity and blocking limits

De-modulation	Tuned frequency band	C Wanted signal centre frequency (MHz)	C Wanted signal level		Required I/C ratio (see notes 1 and 2)			
			Conducted (dBm)	Radiated (dB μ V/m)	N = 1 (dB)	N = 2 (dB)	N = 3 (dB)	Blocking (dB)
DRM	LF	0,216	-91	68	25	35	45	50
	MF	0,999	-91	62	25	35	45	50
	HF1	4	-91	54	25	35	45	50
	HF2	19	-91	54	25	35	45	50
	VHF band I	65	-91	50	35	40	45	50
	VHF band II	100	-92	55	35	40	45	50
	VHF band III	200	-92	61	35	40	45	50
NOTE 1: The frequency of the interferer shall be calculated using the channel spacing data in table 3 for each of the 6 defined adjacent channels $N = \{-3, -2, -1, +1, +2, +3\}$ and the two blocking offsets. Each row of table 4 thus defines 8 individual tests.								
NOTE 2: The minimum level of I for the relevant level of impairment is calculated by adding the I/C ratio to the wanted C level.								

4.3.3 Conformance

Conformance tests as defined in ETSI EN 303 345-1 [1], clause 5.3.5.2 shall be carried out for each DRM band provided by the receiver and for all eight frequency offsets specified in table 3.

The wanted and unwanted signal generators shall be set to produce signals according to table 1. The centre frequency of the wanted signal is set according to table 4. The frequency offset of the unwanted or blocking signal to the wanted signal is set according to table 3. The required wanted signal level shall be as indicated in table 4. The required unwanted or blocking signal level offset shall be as indicated in table 4. If the impairment criteria given in clause 4.3.2 is met for all the test offsets then the receiver has passed the adjacent channel selectivity and blocking requirement.

4.4 Unwanted emissions in the spurious domain

4.4.1 Definition

Spurious domain radiated and conducted (differential voltage) emissions from the equipment.

4.4.2 Limits

The limits for conducted (differential voltage) spurious domain emissions for an external RF port are specified in EN 55032 [3] table A.13, clause 13.1.

The limits for radiated spurious domain emissions are specified in EN 55032 [3] tables A.4 and A5.

4.4.3 Conformance

For receivers with an external antenna connection, conformity shall be assessed by measuring the conducted (conducted differential voltage) emissions from the external RF port and radiated emissions from the cabinet and structure of the equipment (cabinet radiation).

For receivers without an external antenna connection, conformity shall be assessed by measuring the radiated emissions from the cabinet and the built-in or integral antenna (cabinet radiation).

The level of spurious emissions shall be measured according to EN 55032 [3], clause 6.3, clause 8, table A.1, clause A.8.5 in table A.8, annex B, clause C.2.1, clause C.2.2, clause C.2.3, clause C.3.1, clause C.3.2, clause C.3.3, clause C.3.4, clause C.3.7, clause C.4.2, clause C.4.4 and annex D and carried out by conducted (conducted differential voltage) emissions from an external RF port and/or radiated emissions from the cabinet and structure of the equipment (cabinet radiation).

If the limits given in clause 4.4.2 are met then the receiver has passed the unwanted emissions in the spurious domain requirement.

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.

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.2] 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 303 345-5					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Sensitivity	3.2	4.2	U	
2	Adjacent channel selectivity and blocking	3.2	4.3	U	
3	Unwanted emissions in the spurious domain	3.2	4.4	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 (informative): Development of the present document

B.1 Introduction

Broadcasting is a very established use of the radio spectrum, and as such, has a long history of development. This multipart series covering broadcast receivers covers the various modulation schemes that are used for broadcasting in Member States. The essential requirements under the RED [i.1] are identical for each modulation scheme.

B.2 Relevance

All EU Member States have radio broadcasting transmission facilities, although the specific modulation methods used in each Member State vary. Broadcast radio signals travel across national frontiers and so this difference in transmission modulation is less marked in terms of the demodulation methods required in radio receivers for use in the homes, businesses and vehicles of EU citizens.

B.3 Receiver parameters under article 3.2

B.3.1 General

Clause 5.3 of the ETSI guide, ETSI EG 203 336 [i.6], lists the receiver parameters that should be considered when producing Harmonised Standards that aim to cover the essential requirements in article 3.2 of Directive 2014/53/EU [i.1].

The intention of article 3.2 of Directive 2014/53/EU [i.1] in relation to a receiver is explained in recitals 10 and 11 of the Directive which state:

"...in the case of a receiver, it has a level of performance that allows it to operate as intended and protects it against the risk of harmful interference, in particular from shared or adjacent channels, and, in so doing, supports improvements in the efficient use of shared or adjacent channels.

Although receivers do not themselves cause harmful interference, reception capabilities are an increasingly important factor in ensuring the efficient use of radio spectrum by way of an increased resilience of receivers against harmful interference and unwanted signals on the basis of the relevant essential requirements of Union harmonisation legislation."

Broadcast radio receivers operate under spectrum conditions managed by national radio regulators which carefully plan and license broadcast transmitters to use spectrum efficiently and to ensure a diverse content offering. For DRM transmissions in Europe, the GE75 agreement [i.7], GE84 agreement [i.8] or GE06 agreement [i.9] is used as the basis for coordinating the locations and powers of broadcast transmitters.

B.3.2 Receiver sensitivity

Receiver sensitivity is the ability to receive a wanted signal at low input signal levels while providing a pre-determined level of performance.

A specific test for receiver sensitivity is included in the present document (see clause 4.2) because:

- the service area of the licensed broadcast transmitter is defined in terms of the minimum field strength;
- the sensitivity requirement of the receiver needs to be known when specifying other performance parameters.

Sensitivity is specified in line with broadcast planning rules based on Recommendation ITU-R BS.1615-1 [i.10] and Recommendation ITU-R BS.1660-7 [i.11]. As broadcast radio receivers may use either internal or external antennas, limits are specified for both radiated and conducted signals.

B.3.3 Receiver co-channel rejection

Receiver co-channel rejection is a measure of the capability of a receiver to receive a wanted signal, without exceeding a given degradation, due to the presence of an unwanted signal, both signals being at the nominal frequency of the receiver.

A specific test for co-channel rejection is not included because DRM is designed to operate in single frequency networks. Therefore the receiver makes use of all the signal energy within the active symbol period of the OFDM carrier block.

Broadcast planning ensures that transmission power levels and reuse distances of the same frequency for different DRM signals are coordinated to minimize the amount of co-channel energy.

B.3.4 Receiver selectivity

B.3.4.1 General

Receiver selectivity is described in Recommendation ITU-R SM.332-4 [i.12] identifying the capability to receive a wanted signal, without exceeding a given degradation, due to the presence of an unwanted signal, which differs in frequency from the wanted signal by a specified amount.

B.3.4.2 Single signal selectivity

B.3.4.2.1 Receiver adjacent signal selectivity (adjacent channel selectivity)

A specific test for ACS is included in the present document (see clause 4.3) because planning of the broadcast spectrum assumes that receivers will achieve a certain minimum selectivity. The receiver is tested with a modulated noise signal present in one of the three channels below and above the wanted channel (i.e. ± 1 , ± 2 and ± 3 channels). These channel offsets provide the most critical interference scenarios that will be encountered by a receiver.

ACS is specified in line with broadcast planning rules based on Recommendation ITU-R BS.1615-1 [i.10] and Recommendation ITU-R BS.1660-7 [i.11]. As broadcast radio receivers may use either internal or external antennas, limits are specified for both radiated and conducted signals.

B.3.4.2.2 Receiver spurious response rejection

The spurious response rejection is a measure of the capability of the receiver to receive a wanted signal without exceeding a given degradation due to the presence of an unwanted signal at any frequency at which a response is obtained. The frequencies of the adjacent signals (channels) are excluded.

A specific test for spurious response rejection is not included in the present document because the design architecture of the receiver would need to be known in order to determine the critical test parameters to provide an economically proportionate testing regime. Broadcast receivers have not historically suffered specifically from this issue.

B.3.4.3 Receiver multiple signal selectivity

B.3.4.3.1 Receiver blocking

Receiver blocking is a measure of the capability of the receiver to receive a wanted signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequency other than those of the spurious responses or of the adjacent channels.

A specific test for receiver blocking is included in the present document (see clause 4.3) because narrowband high-level interference from other sources may be present. The blocking signal is specified at a much greater separation to the wanted signal than for the ACS testing and the test is designed to ensure receivers can cope with high signal levels at a frequency away from the wanted signal. As broadcast radio receivers may use either internal or external antennas, limits are specified for both radiated and conducted signals.

B.3.4.3.2 Receiver radio-frequency intermodulation

The receiver radio-frequency intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal, without exceeding a given degradation due to the presence of at least two unwanted signals at frequencies F_1 and F_2 with a specific frequency relationship to the wanted signal frequency.

A specific test for receiver radio-frequency intermodulation response rejection is not included in the present document because intermodulation in the RF tuner will result in a degradation in the adjacent channel selectivity, which is extensively tested.

B.3.4.3.3 Receiver adjacent signal selectivity (adjacent channel selectivity)

Receiver adjacent signal selectivity (adjacent channel selectivity) can be part of multiple signal selectivity because attenuation of the interfering signal will require linear signal processing in the receiver even if the specified interferer is a constant envelope signal.

A specific test for ACS with multiple interferers is not included in the present document because NZIF technology is not used and broadcast planning is designed to ensure that adjacent channel interference levels are not significantly higher than the wanted signal. Broadcast planning is coupled with effective regulation and enforcement.

B.3.4.4 Other receiver effects

B.3.4.4.1 Receiver dynamic range

Receiver "dynamic range" is a generic term broadly defined as the range of input signal levels over which a receiver functions at a specified performance level.

A specific test for receiver dynamic range is not included in the present document because the sensitivity, ACS and blocking tests provide testing of both low- and high-level signal situations.

B.3.4.4.2 Reciprocal mixing

Reciprocal mixing is where noise sidebands of the Local Oscillator (LO) mix with unwanted signals producing unwanted noise at the frequency of the receiver which may result in degraded receiver sensitivity. In direct Digital Down Conversion receivers (DDC) a similar effect occurs caused by the phase jitter of the clock associated with the ADC.

A specific test for reciprocal mixing is not included in the present document because the effect of reciprocal mixing is to degrade the ACS performance, which is tested. The ACS performance is measured with the wanted signal at a low level and so any noise resulting from reciprocal mixing will cause an apparent decrease in the sensitivity of the receiver, which in turn makes the ACS requirement harder to meet.

B.3.4.4.3 Desensitization

Desensitization is a degradation of receiver sensitivity caused by the presence of a large unwanted signal. The term is most commonly applied when an unwanted signal is present in the receiver which is above a receiver's linear "dynamic range" resulting in desensitization for example by the process of gain compression.

A specific test for desensitization is not included in the present document because the blocking test addresses this potential problem by testing performance in the presence of a large unwanted signal.

B.3.5 Receiver unwanted emissions in the spurious domain

A specific test for receiver unwanted emissions in the spurious domain is included in the present document (see clause 4.4).

Annex C (informative): Change History

Version	Information about changes
1.1.1	First published version.
1.2.1	Requirements for unwanted emissions in the spurious domain added.

History

Document history		
V1.1.1	February 2020	Publication
V1.2.0	September 2021	EN Approval Procedure AP 20211221: 2021-09-22 to 2021-12-21
V1.2.1	December 2021	Publication