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Radio Broadcast Receivers;
Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

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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 to provide a means of conforming to the essential requirements of 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.1].

NOTE: The corresponding Commission's standardization request is expected shortly.

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
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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 describes the requirements for radio broadcast receivers to meet the essential requirements of article 3.2 of the Radio Equipment Directive [i.1].

1 Scope

The present document applies to devices that receive broadcast radio services, whether analogue or digital modulation is used. Multi-function devices may also fall under the requirements of other documents.

The present document contains requirements to demonstrate that radio equipment both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.

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 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.

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

[1] ETSI EN 300 401 (V1.4.1) (06-2006): "Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers".

[2] IEC 62104:2015: "Characteristics of DAB receivers".

[3] ETSI ES 201 980 (V4.1.1) (01-2014): "Digital Radio Mondiale (DRM); System Specification".

[4] CENELEC EN 55032:2015: "Electromagnetic compatibility of multimedia equipment - Emission Requirements".

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.

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

[i.1] Official Journal of the European Union L 153/62: "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] ETSI TR 100 028-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1".

[i.3] ETSI TR 100 028-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

[i.4] ECA table at www.efis.dk.

[i.5] Recommendation ITU-R BS.1615-1: "Planning parameters' for digital sound broadcasting at frequencies below 30 MHz".

[i.6] Recommendation ITU-R BS.641: "Determination of radio-frequency protection ratios for frequency-modulated sound broadcasting".

[i.7] CEPT/ERC/Recommendation 74-01E (2011): "Unwanted emissions in the spurious domain".

[i.8] IEC 60315-1:1988/ COR1:1997: "Methods of measurement on radio receivers for various classes of emission. Part 1: General considerations and methods of measurement, including audio-frequency measurements".

3 Definitions and abbreviations

3.1 Definitions

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

adjacent channel selectivity: 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 modulated interference signal in an adjacent channel separated from the wanted signal channel by a specified frequency offset

broadcast receiver tuner port: radio receiver tuner RF input connector

radio equipment: broadcast radio receiver comprising at least tuner and demodulator

3.2 Abbreviations

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

ACS	Adjacent Channel Selectivity
AM	Amplitude Modulation
AMSS	Amplitude Modulation Signalling System
BER	Bit Error Rate
BS	Broadcast Sound
DAB	Digital Audio Broadcasting
DC	Direct Current
DRM	Digital Radio Mondiale
ECA	European Common Allocation
EFTA	European Free Trade Area
EMF	ElectroMotive Force
FM	Frequency Modulation
HF	High Frequency
IEC	International Electrotechnical Commission
ITU-R	International Telecommunications Union - Radiocommunications
LF	Low Frequency
MF	Medium Frequency
PC	Personal Computer
RDS	Radio Data System
RF	Radio Frequency
TEM	Transverse Electro-Magnetic
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 declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

4.2 Conformance requirements

4.2.1 Broadcast radio modulation methods

The following broadcast radio modulation methods are considered feasible within the current authorization regime in Europe:

- Amplitude modulation, with or without AMSS.
- Frequency modulation, with or without RDS.
- Digital Audio Broadcasting.
- Digital Radio Mondiale.

Broadcast radio receivers may include demodulation capability for one or more of these modulation methods. Conformance shall only be required for each of the modulation methods included in the receiver.

4.2.2 Broadcast radio frequency bands

The following frequency bands are identified in the ECA table [i.4] for broadcast radio services:

- Low frequency (LF): 148,5 to 283,5 kHz.
- Medium frequency (MF): 526,5 to 1 606,5 kHz.
- High Frequency (HF): 3 950 to 4 000 kHz, 5 900 to 6 200 kHz, 7 200 to 7 450 kHz, 9 400 to 9 900 kHz, 11 600 to 12 100 kHz, 13 570 to 13 870 kHz, 15 100 to 15 800 kHz, 17 480 to 17 900 kHz, 18 900 to 19 020 kHz, 21 450 to 21 850 kHz, 25 670 to 26 100 kHz.
- VHF band I: 47 to 68 MHz.
- VHF band II: 87,5 to 108 MHz.
- VHF band III: 174 to 240 MHz.

Broadcast radio receivers may include tuning capability for one or more of these frequency bands. Conformance shall only be required for each of the frequency bands included in the receiver.

NOTE: L-band (1 492 to 1 479,5 MHz) is listed in the current ECA for terrestrial DAB but is not in general use.

4.2.3 Configurations for testing

4.2.3.1 AM

The generated AM signals shall be in accordance with table 1. The configuration is based on Recommendation ITU-R BS.1615-1 [i.5].

Table 1: AM configuration

Parameter	**AM Signals**	
	Wanted	*Unwanted*
Audio Modulation	1 kHz tone	Weighted noise
	Band-limited to 4,5 kHz	
	40 % peak	50 % quasi-peak

4.2.3.2 FM

The generated FM signals shall be in accordance with table 2. The configuration is based on Recommendation ITU-R BS.641 [i.6].

Table 2: FM configuration

Parameter	FM Signals	
	Wanted	*Unwanted*
Audio Modulation	1 kHz tone, L = R	Weighted noise, L = R
	Band-limited to 15 kHz	
	60,75 kHz peak deviation	32 kHz quasi-peak deviation
Pilot Tone	19 kHz	None
	6,08 kHz peak deviation	-

4.2.3.3 DAB

The generated DAB signals (wanted and unwanted) shall be in accordance with ETSI EN 300 401 [1].

4.2.3.4 DRM

The generated DRM signals (wanted and unwanted) shall be in accordance with ETSI ES 201 980 [3].

4.2.4 Adjacent channel selectivity and blocking

4.2.4.0 Definition

The selectivity of a receiver is a measure of its ability to discriminate between a wanted signal to which the receiver is tuned and unwanted signals entering the broadcast receiver tuning port.

4.2.4.1 General requirements

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. The first, second and third adjacent channels both above and below the tuned signal shall be tested. In addition, testing shall also be performed to check the ability of the receiver to work effectively with signals at a greater separation from the wanted signal, known as blocking or far-off selectivity. The channel spacing specified in table 3 shall apply.

Table 3: Channel spacing for adjacent channel selectivity and blocking

Demodulation	Tuned frequency band	Wanted frequency	Unwanted frequency (N = 1,2 or 3)	Unwanted frequency (blocking)
AM	LF	216 kHz	±Nx9 kHz	±90 kHz
	MF	999 kHz	±Nx9 kHz	±90 kHz
	HF	see note	±Nx10 kHz	±100 kHz
FM	VHF band II	100 MHz	±Nx100 kHz	±800 kHz
DAB	VHF band III	202,160 MHz	±Nx1 712 kHz	±12 MHz
DRM	LF	216 kHz	±Nx9 kHz	±90 kHz
	MF	999 kHz	±Nx9 kHz	±90 kHz
	HF	see note	±Nx10 kHz	±100 kHz
	VHF band I	65 MHz	±Nx100 kHz	±800 kHz
	VHF band II	100 MHz	±Nx100 kHz	±800 kHz
	VHF band III	200 MHz	±Nx100 kHz	±800 kHz
NOTE: For the HF bands, the wanted frequency should be chosen to be the closest 10 kHz to the centre of the tuned frequency band.				

4.2.4.2 Limits

The limits specified in table 4 shall apply.

Table 4: Minimum adjacent channel selectivity and blocking requirements

Demodulation	Tuned frequency band	1st adjacent dB	2nd adjacent dB	3rd adjacent dB	Blocking dB
AM	LF	30	40	45	45
	MF	30	40	45	45
	HF	30	40	45	45
FM	VHF band II	-23	3	17	30
DAB	VHF band III	35	40	45	40
DRM	LF	25	35	45	50
	MF	25	35	45	50
	HF	25	35	45	50
	VHF band I	35	40	45	50
	VHF band II	35	40	45	50
	VHF band III	35	40	45	50

4.2.4.3 Conformance

Conformance tests as defined in clause 5.3.1 shall be carried out. Only demodulation systems supported by the receiver shall be tested. Only bands supported by the receiver shall be tested.

4.2.5 Unwanted emissions in the spurious domain

4.2.5.1 Definition

Unwanted emissions in the spurious domain are emissions from the equipment in the frequency range defined by CEPT/ERC/Recommendation 74-01E [i.7].

4.2.5.2 Limits

The limits in CENELEC EN 55032 [4], Class B shall not be exceeded.

4.2.5.3 Conformance

Manufacturers shall provide a representative sample of the receiver system. The level of spurious emissions shall be measured by either:

a) conducted (conducted differential voltage) emissions from an external RF port; and radiated emissions from the cabinet and structure of the equipment (cabinet radiation); or

b) radiated emissions from the cabinet and the integral antenna.

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

4.2.6 Sensitivity

4.2.6.1 Definition

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

Receiver sensitivity is only specified for digital systems. The AM and FM bands are characterized by wide variations in the level of co-channel interference and therefore specifying a minimum requirement for sensitivity creates a limitation to the solutions provided by manufacturers. DAB and DRM have been designed to cope with variable levels of interference and system performance is determined by ensuring sufficient sensitivity.

4.2.6.2 Limits

4.2.6.2.1 AM

No limit is specified.

4.2.6.2.2 FM

No limit is specified.

4.2.6.2.3 DAB

The minimum requirement is -97,7 dBm.

4.2.6.2.4 DRM

The limits specified in table 5 shall apply.

Table 5: Minimum sensitivity requirements for DRM

Measurement condition	LF	MF	HF below 6,2 MHz	HF above 6,2 MHz	VHF band I	VHF band II	VHF band III
Field strength (TEM cell measurement)	58 dBµV/m	52 dBµV/m	44 dBµV/m	40 dBµV/m	45 dBµV/m	46 dBµV/m	51 dBµV/m
Voltage at signal generator output (Portable receiver network)	80 dBµV	74 dBµV	66 dBµV	62 dBµV	71,5 dBµV	72,5 dBµV	77,5 dBµV
Voltage at signal generator output (Portable receiver high level network)	49 dBµV	43 dBµV	35 dBµV	31 dBµV	42 dBµV	43 dBµV	48 dBµV
Voltage at signal generator output (Car receiver network or without network)	8 dBµV	8 dBµV	8 dBµV	8 dBµV	9 dBµV	9 dBµV	9 dBµV
NOTE 1: The requirements in table 5 are defined for the receiver including casing. Hence modules need better values to compensate for losses of the casing. NOTE 2: It has to be taken into account that the sensitivity of the receiver measured with a cable to the broadcast receiver tuning port should be better than stated in table 5 to compensate for additional receiver internal interferences when measuring the sensitivity with built-in antenna.							

When stating the sensitivity performance of a receiver with built-in antenna, a precise description of the measurement set-up including TEM-cell type, size and calibration method has to be given.

4.2.6.3 Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out. Only demodulation systems supported by the receiver shall be tested. Only bands supported by the receiver shall be tested.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

The equipment shall be tested under normal test conditions according to the relevant product and basic standards or to the information accompanying the equipment, which are within the manufacturers declared range of humidity, temperature and supply voltage. The test conditions shall be recorded in the test report.

5.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- 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 shall be included in the test report;

- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 6.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Principles for the calculation of measurement uncertainty are contained in ETSI TR 100 028-1 [i.2], in particular in annex D of the ETSI TR 100 028-2 [i.3].

Table 6 is based on such expansion factors.

Table 6: Maximum measurement uncertainty

Parameter	Uncertainty
Interferer power level measured in the adjacent channel selectivity and blocking tests	±3 dB
ACS measured in the adjacent channel selectivity and blocking tests	±3 dB
Spurious emissions	See CENELEC EN 55032 [4]

5.3 Methods of measurement

5.3.1 Adjacent channel selectivity and blocking

5.3.1.1 AM-into-AM and FM-into-FM

5.3.1.1.1 Test arrangement and description

The set-up is illustrated in figure 1.

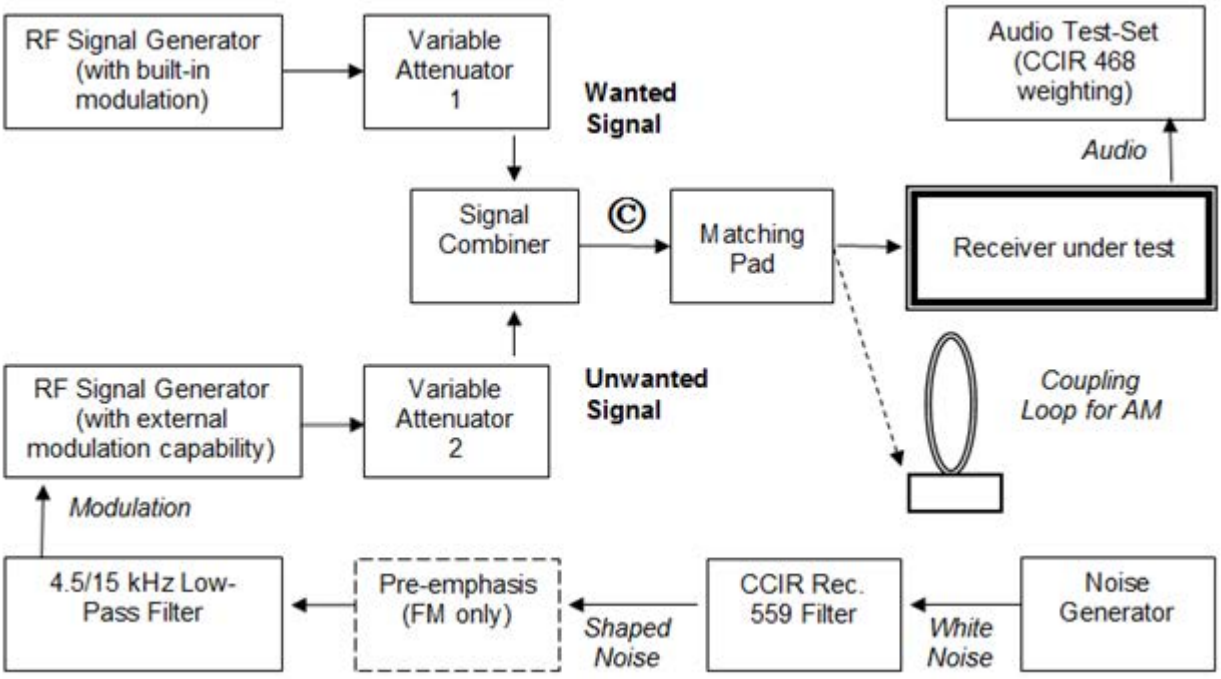

Figure 1: Generic analogue measurement arrangement

1) The interferer modulation can be generated by a PC and sound-card. However, it is important to check that no spurious components are present outside the required modulation bandwidth.

2) Care should be taken with the RF connections and cables. Where high values of attenuation are required, any cross-coupling can invalidate the results.

3) It is good practice to include a 50/50 Ω or 50/75 Ω matching pad between the test equipment and the broadcast receiver tuning port. A minimum-loss pad can be taken as introducing a loss of 6 dB. In other words, the power presented to the receiver is 6 dB below that measured at the calibration point ©.

4) All FM receivers should be equipped with a socket for an external antenna. Where this is not the case an appropriate coupling method should be used, or the test should be performed in a suitable R.F. chamber.

5) Where the AM receiver possesses an internal ferrite-rod antenna and no external antenna socket, a coupling loop should be used. A Meguro MLA-1001B is suitable.

6) All receivers should possess an accessible audio output. Where this is not the case an appropriate acoustic coupling method should be used.

5.3.1.1.2 Measurement procedures

1) The wanted signal shall be set to the wanted signal frequency as shown in table 3 and configured with the appropriate AM or FM parameters (tables 1 and 2). Note that noise modulation should be checked with a modulation analyser possessing a quasi-peak detector.

2) The unwanted signal shall be set to the unwanted signal frequency as shown in table 3 and configured with the appropriate AM or FM parameters (tables 1 and 2). Note that noise modulation should be checked with a modulation analyser possessing a quasi-peak detector.

3) With both variable attenuators set to 0 dB, adjust both generators for equal power at ©. The power level needs to be high: e.g. +13 dBm, to cater for large positive protection ratios.

4) Disable the unwanted signal generator and set the wanted signal generator to a sensible power level: e.g. -40 dBm. Measure the audio tone level at the output of the receiver and note this as the reference. Check that the total harmonic distortion is below 1 % - a higher figure could indicate that the receiver is not correctly tuned.

5) Disable the modulation on the wanted signal generator, and set Variable Attenuator 1 so that the quasi-peak weighted noise at the receiver output is 46 dB (FM) or 28 dB (AM) below the reference.

6) Enable the unwanted signal generator and adjust Variable Attenuator 2 so that the quasi-peak weighted noise is 40 dB (FM) or 22 dB (AM) below the reference.

   The adjacent channel selectivity shall be recorded in the measurement record (table 7). If the settings of Variable Attenuators 1 and 2 are A_1 [dB] and A_2 [dB] respectively, the adjacent channel selectivity A_{CS} is given by:

$$A_{CS} = A_1[dB] - A_2 [dB]$$

7) Repeat steps 1 to 6 for the remaining tests in table 3.

Some further notes are:

1) It is assumed that the 'backstop' audio noise - i.e. that at high levels of wanted signal - is better than 50 dB (FM) or 32 dB (AM) below the reference.

2) For AM, a noise level of 32 dB below the reference is equivalent to 40 dB below the reference that would have been obtained with 100 % modulation depth. (Some receivers could introduce severe distortion at full modulation.)

3) In practice, it might be more convenient to set the two generators for unequal powers at ©, and then make due allowance when calculating A_{CS} from A_1[dB] and A_2 [dB]. Large values of A_1 and A_2 are best avoided because of the increased risk of cross-coupling between the interconnections.

4) The FM selectivity requirement has been reduced by 10 dB from that given in Recommendation ITU-R BS.641 [i.6]. The original backstop noise requirement of better than 60 dB below the reference is difficult to achieve with domestic equipment.

5) If the AM receiver is incorrectly tuned, the figures for A_{CS} will be highly asymmetric about carrier. Where the receiver does not use a synthesised local oscillator, a dummy measurement run should be carried out, during which small tuning adjustments are made for the most symmetrical results.

Table 7: Measurement record

Adjacency	Required selectivity limit for AM and FM configurations in tables 1 and 2 dB		Measured selectivity limit for AM and FM configurations in tables 1 and 2 dB		Test temperature °C	Test humidity %	Measurement uncertainty ± dB
	AM	FM	AM	FM			
1	30	-23					
2	40	3					
3	45	17					
Blocking	>45	>30					

5.3.1.2 DAB

The method used shall be that specified in IEC 62104:2015 [2], clauses 7.7.2 for ACS and 7.7.3 for blocking.

5.3.1.3 DRM

5.3.1.3.1 Test arrangement and description

The measurement set up is depicted in figure 2. Both wanted signal and interferer shall be DRM signals according to clause 4.2.3.4. The spectrum occupancy for both DRM signals shall be 2 (9 kHz) for tests in the LF or MF bands, 3 (10 kHz) for tests in the HF band or 0 (100 kHz) for tests in VHF bands I, II or III. The spectrum of the signal generators shall have an intermodulation shoulder (measured at half the channel spacing from centre frequency) of more than 45 dB and a sufficiently low noise floor. Signal Generator 1 produces the wanted signal; Signal Generator 2 produces the unwanted signal. The antenna network shall be according to annex B.

The distance between the centre frequencies of the DRM signals depends on the selected neighbouring channel (see table 3). Upper and lower adjacent channels shall be tested.

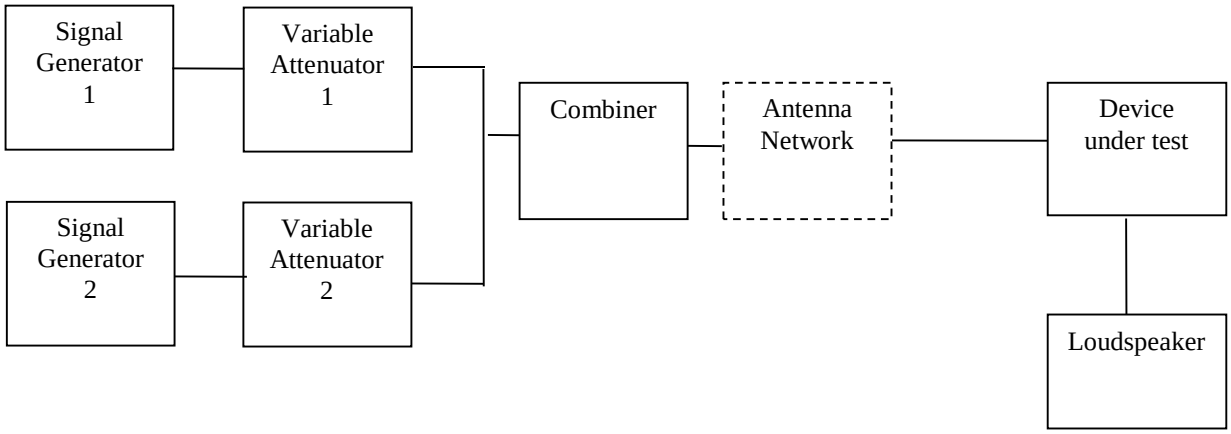

Figure 2: Block diagram for DRM selectivity measurements

5.3.1.3.2 Measurement procedures

The level of the wanted signal P_{wanted} at the broadcast receiver tuning port shall be adjusted to 10 dB above the minimum sensitivity level required in table 5 using the Variable Attenuator 1 when Signal Generator 2 is switched off. The signal level $P_{unwanted}$ of the interfering signal shall then be increased until a BER of 10^{-4} is reached.

Presentation of results

The adjacent channel selectivity A_{CS} of the device is expressed in dB. The value shall be calculated from the adjusted signal levels by the following equation:

$$A_{CS} = P_{unwanted}\ [dB] - P_{wanted}\ [dB]$$

The unwanted signal can be on either side of the wanted signal in frequency representation. The worse A_{CS} value for each frequency spacing shall be noted.

5.3.2 Unwanted emissions in the spurious domain

5.3.2.1 Methods of measurement

Refer to CENELEC EN 55032 [4].

5.3.3 Sensitivity

5.3.3.1 DAB

The method used shall be that specified in IEC 62104:2015 [2], clauses 7.4 for conducted measurement and 7.5 for radiated measurement.

5.3.3.2 DRM

5.3.3.2.1 Test arrangement and description - conducted measurement

The measurement setup is given in figure 3. The signal generator shall be connected to the broadcast receiver tuning port of the receiver under test. The BER shall be measured at the output. The input level is reduced until the BER reaches 10^{-4}. The antenna network shall be according to annex B.

The measurement shall be done for each supported type of power supply. Thus battery/mains receivers shall be tested while running on internal batteries as well as while mains operated.

NOTE: The operation with a mains adaptor could improve the sensitivity or decrease the sensitivity because of additional interferences.

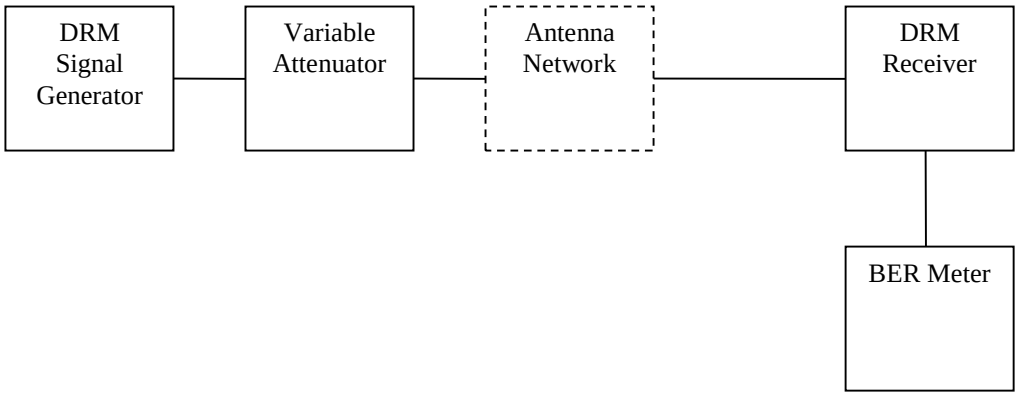

Figure 3: Block diagram for the measurement of sensitivity

5.3.3.2.2 Test arrangement and description - radiated measurement

The measurements are split for E-feld antennas as rod antennas and H-field antennas as ferrite rod and magnetic loop antennas. According the used antenna types in the receiver the appropriate measurement setup for the relevant frequency ranges have to be chosen. The measurements shall be executed on a number of selected frequencies per frequency category to ensure the performance. The measurement shall be done for each supported type of power supply. Thus battery/mains receivers shall be tested while running on internal batteries as well as while mains operated according to figures 4 and 5.

The sensitivity of the receiver should be measured by means of a TEM-cell or GTEM-cell. In that way, the receiver will be subjected to uniform E- and H-fields in the correct proportion. To get accurate results the minimum height for the cell should be at least 1,5 m and the maximum variation in field-strength over the volume occupied by the receiver-under-test including antenna should be less than ±3 dB.

The measurements should be carried out at intervals of no greater than 100 kHz on LF and MF, and 1 MHz on HF and VHF.

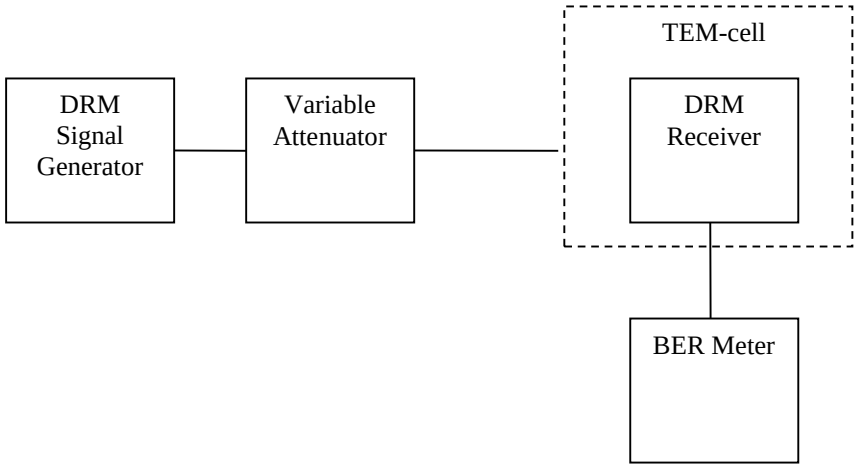

Figure 4: Block diagram for the measurement of sensitivity in a TEM-cell

Where the receiver is to be tested while running on internal batteries, it should be placed midway between the floor and septum of the TEM-cell. Before testing starts, the E-field at the midpoint should be checked using a calibrated probe. The calibration has to take potential differences of the detector between CW-signals and DRM-signals into account. The probe should also be used to ensure that the field variation does not exceed ±3 dB, relative to its midpoint value, over the height occupied by the receiver and antenna. The receiver and antenna should occupy no more than half the distance between the floor and septum.

Where the receiver is to be powered by mains adapter, the receiver and power cable should be placed on the floor of the TEM-cell. The E-field needs to be checked appropriately, as indicated in figure 5.

No connections other than the power supply should be made to the receiver.

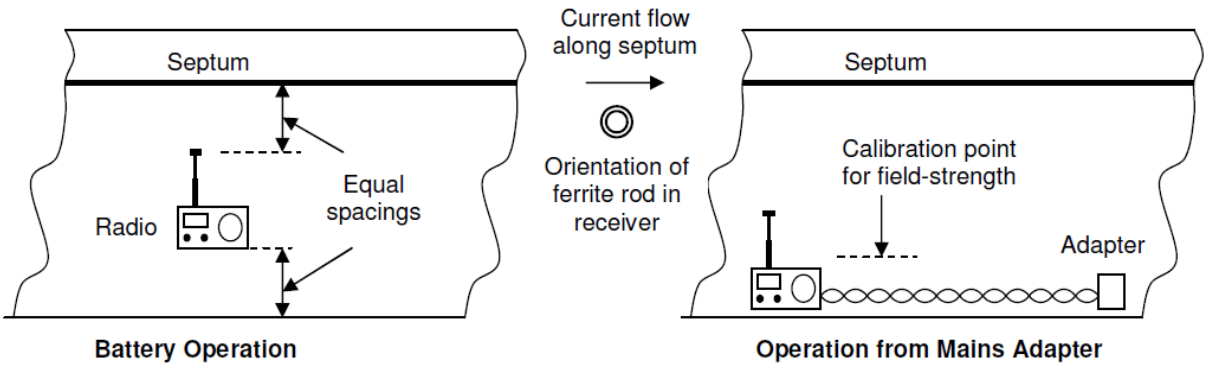

Figure 5: Diagram to show the positioning of receiver in TEM-cell

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

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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 [i.1]

Harmonised Standard ETSI EN 303 345 The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.1]				
Requirement			**Requirement Conditionality**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**
1	Receiver adjacent channel selectivity and blocking	4.2.4	U	
2	Unwanted emissions in the spurious domain	4.2.5	U	
3	Sensitivity	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.

Clause Number 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 shall be unconditionally applicable (U) or is conditional upon the manufacturers claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement shall or shall not be 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): Antenna systems for DRM measurements

B.1 General

Different kinds of antennas are suitable for different applications. Portable receivers are usually provided with high-impedance, electrically-short whip antennas. The receiver shall present such an antenna with a high-impedance load to prevent excessive signal loss. Car radios generally also have high-impedance inputs, although a typical antenna arrangement has a low-impedance output. Professional receivers would normally be provided with 50 Ω inputs.

When testing the sensitivity of a portable receiver, it is recommended that the normal antenna is connected and the complete receiver placed within a TEM-cell. In addition, an emulation network can be used, as detailed in clause B.3. An emulation network for car radios is given in clause B.4. The emulation network shall always be connected directly to the receivers RF input to prevent impedance change originating from additional cables.

B.2 50 Ω antenna system

DRM receivers developed with 50 Ω RF-input impedance can be connected directly to signal generators. The defined voltage values can be set directly at the signal generator.

B.3 Emulation network for measurements

The antenna emulation network is necessary to provide a convenient way of measuring the receiver performance under realistic conditions of source impedance and EMF. The network is designed such that at a given input power level, the output is equivalent to that of a standard antenna in a field strength of 0 dBµV/m.

A suitable emulation network is provided for a short (0,7 m) whip antenna of average diameter 5 mm, attached to a receiver of a reasonable size (250 x 150 x 100 mm). This arrangement is considered to be typical of what might be used in a typical portable ("kitchen") receiver. The circuit values are derived from a combination of theoretical analysis and practical measurement. The effective length is assumed, from theory, to be 0,35 m. However, due to the small dimensions of the ground plane, this may not be strictly accurate.

It will be clear that the performance of the antenna will be critically dependent on the dimensions of the ground plane and the presence of any external cabling such as power supply leads etc. Manufacturers should measure the sensitivity and other parameters assuming the worst case, i.e. for a battery powered receiver, the unit should be measured while running on its own batteries and placed on a non-conductive surface.

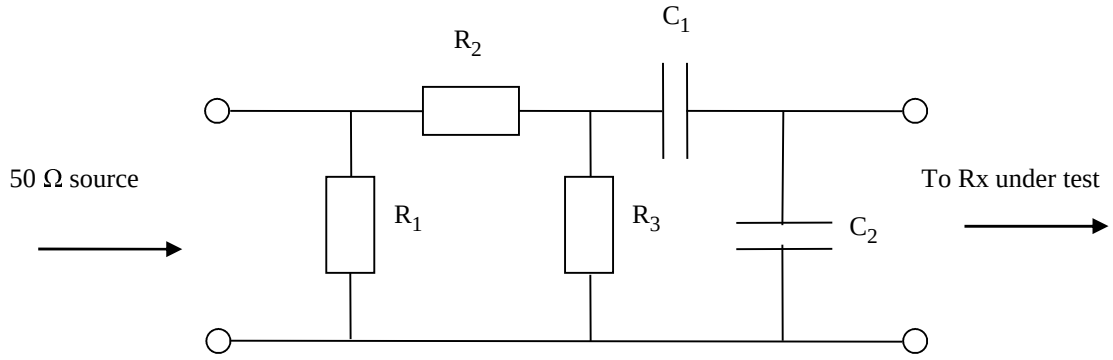

Figure B.1: Diagram of antenna network

The network is shown in figure B.1. It is up to the receiver manufacturer to determine whether the values used are representative for their particular receiver. Emulation networks for magnetic (H-field, or loop) antennas are not provided. This is because firstly, it will be very difficult to make a connection to a receiver which uses an H-field antenna without disturbing the circuit conditions (as such antennas usually form part of a high Q tuned circuit), and secondly, that generation of a known field strength for measurement purposes is relatively straightforward.

For the aforementioned antenna, the following values are suggested:

R1 = 180 Ω

R2 = 68 Ω

R3 = 5,1 Ω

C1 = 6,8 pF

C2 = 3,9 pF

For these values, an input level of -85 dBm (22 dBµV) is equivalent to a field strength of 0 dBµV/m. This level is chosen as a compromise between convenience and output level requirement of the signal source. It is found from both theory and measurement that a single emulation network may be used for the entire frequency range, assuming that the antenna is electrically short compared with the shortest wavelength used (11 m). In practice, this will be true of most antennas that are supplied with DRM receivers, so this network is a reasonable one to use for test purposes. If any larger antenna is used, for instance by a radio enthusiast, the effective sensitivity will be improved.

Unless there is good reason, in any specific situation, to do otherwise, it is suggested that receiver manufacturers assume that an electrically-short whip will be used as an antenna.

If another emulation network is used the receiver manufacturer shall give reasons for it. The network circuit and the conversion factor between field strength and input level shall be provided.

B.4 Emulation network for car receivers

The emulation network described is applicable for receivers with high impedance designed for active antennas with 50 Ω. This is a typical case for car receivers. The network is derived from a description in IEC 60315-1 [i.8].

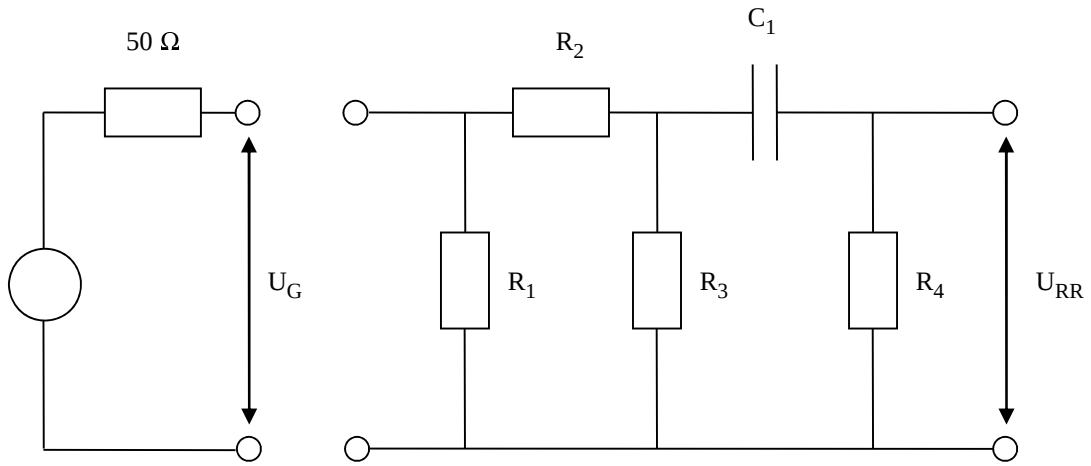

Figure B.2: Diagram of antenna network for car receivers

The following values are given:

R_1 = 150 Ω

R_2 = 37,5 Ω

R_3 = 470 Ω

R_4 = 220 Ω (load for remote power supply)

C_1 = 470 nF (blocking of DC components of the receiver)

$U_G = U_R$ is valid.

This assumption is valid if the signal generator has a 50 Ω impedance output and the receiver has a high impedance input. The loss of the network is compensated by the mismatching between signal generator and antenna network. The reason for it is that the signal generator sees a higher impedance when connected to the network and delivers a higher voltage.

All in the following sections defined voltage values shall be set at the signal generator when using this antenna network. The attenuation of the network is independent of the used frequency and the input impedance of the receiver (for an impedance higher than 300 Ω).

B.5 Active antenna for car receivers

Parameters for active antennas are given in IEC 62104:2015 [2], clause 5.2.3.2.

History

Document history			
V1.1.0	July 2015	EN Approval Procedure	AP 20151127: 2015-07-30 to 2015-11-27