



**Broadcast Sound Receivers;  
Part 3: FM broadcast sound service;  
Harmonised Standard for access to radio spectrum**

---

**Reference**DEN/ERM-TG17-153

---

---

**Keywords**analogue, broadcast, harmonised standard,  
radio, receiver

---

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

---

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

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

---

**Important notice**

---

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at [www.etsi.org/deliver](http://www.etsi.org/deliver).

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

---

**Copyright Notification**

---

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2019.

All rights reserved.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.

**3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

**oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

**GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

# Contents

Intellectual Property Rights .....	5
Foreword.....	5
Modal verbs terminology.....	6
Introduction .....	6
1 Scope .....	7
2 References .....	7
2.1 Normative references .....	7
2.2 Informative references.....	7
3 Definition of terms, symbols and abbreviations.....	8
3.1 Terms.....	8
3.2 Symbols.....	8
3.3 Abbreviations .....	9
4 Technical requirements specifications .....	9
4.1 Test signal configurations .....	9
4.2 Sensitivity.....	10
4.2.1 Definition.....	10
4.2.2 Limits.....	10
4.2.3 Conformance.....	10
4.3 Adjacent channel selectivity and blocking .....	11
4.3.1 Definition.....	11
4.3.2 Limits.....	11
4.3.3 Conformance.....	12
5 Testing for compliance with technical requirements.....	12
5.1 Environmental conditions for testing .....	12
5.2 Interpretation of the measurement results .....	12
<b>Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU .....</b>	<b>13</b>
<b>Annex B (informative): Test signal generation.....</b>	<b>14</b>
<b>Annex C (informative): Development of the present document.....</b>	<b>17</b>
C.1 Introduction .....	17
C.2 Relevance .....	17
C.3 Receiver parameters under article 3.2 .....	17
C.3.1 General .....	17
C.3.2 Receiver sensitivity .....	17
C.3.3 Receiver co-channel rejection .....	18
C.3.4 Receiver selectivity .....	18
C.3.4.1 General.....	18
C.3.4.2 Single signal selectivity .....	18
C.3.4.2.1 Receiver adjacent signal selectivity (adjacent channel selectivity).....	18
C.3.4.2.2 Receiver spurious response rejection .....	18
C.3.4.3 Receiver multiple signal selectivity .....	18
C.3.4.3.1 Receiver blocking .....	18
C.3.4.3.2 Receiver radio-frequency intermodulation.....	19
C.3.4.3.3 Receiver adjacent signal selectivity (adjacent channel selectivity).....	19
C.3.4.4 Other receiver effects.....	19
C.3.4.4.1 Receiver dynamic range .....	19
C.3.4.4.2 Reciprocal mixing .....	19
C.3.4.4.3 Desensitization .....	19

C.3.5	Receiver unwanted emissions in the spurious domain .....	20
<b>Annex D (informative):</b>	<b>Change History .....</b>	<b>21</b>
History .....		22

# Intellectual Property Rights

## Essential patents

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

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

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

# 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.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 3 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].

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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

---

## 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 FM 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 the test signal configuration and the limits for sensitivity, selectivity and blocking for devices that receive FM broadcast sound services.

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 specific, identified by date of publication and/or edition number or version number. Only the cited version 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] Recommendation ITU-R BS.468-4 (07/1986): "Measurement of audio-frequency noise voltage level in sound broadcasting".
- [3] Recommendation ITU-R BS.559-2 (06/1990): "Objective measurement of radio-frequency protection ratios in LF, MF and HF broadcasting".

### 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] 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] ETSI TR 100 028 (all parts) (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [i.4] ETSI TR 100 028-2 (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

- [i.5] Recommendation ITU-R BS.641 (07/1986): "Determination of radio-frequency protection ratios for frequency-modulated sound broadcasting".
- [i.6] AES17: "AES standard method for digital audio engineering - Measurement of digital audio equipment".
- [i.7] 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.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] Recommendation ITU-R BS.412-9 (12/1998): "Planning standards for terrestrial FM sound broadcasting at VHF".
- [i.10] Recommendation ITU-R SM.332-4 (07/1978): "Selectivity of Receivers".
- [i.11] CENELEC EN 55032:2015: "Electromagnetic compatibility of multimedia equipment - Emission Requirements".

---

## 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

**crest factor:** peak to rms voltage ratio

**external antenna:** antenna designed to be connected to the equipment with the use of a 50  $\Omega$  or 75  $\Omega$  external connector

**integral antenna:** antenna which is detachable from the equipment without the use of any tools, and not using a 50  $\Omega$  or 75  $\Omega$  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.6]

**dBm:** decibels relative to 1 mW of power

**dBQ:** audio decibels after Recommendation ITU-R BS.468-4 [2] noise weighting and a quasi-peak detector have been applied

**dB $\mu$ V/m:** decibels relative to 1  $\mu$ V/m



### 3.3 Abbreviations

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

ACS	Adjacent Channel Selectivity
ADC	Analogue to Digital Converter
ALC	Automatic Level Control
AM	Amplitude Modulation
BS	Broadcast Sound
BW	BandWidth
DDC	Direct Digital Conversion
EFTA	European Free Trade Association
EMCD	ElectroMagnetic Compatibility Directive
EU	European Union
FM	Frequency Modulation
IQ	In-phase and Quadrature
ITU-R	International Telecommunications Union - Radiocommunications sector
LO	Local Oscillator
NZIF	Near-Zero Intermediate Frequency
PC	Personal Computer
RED	Radio Equipment Directive
RF	Radio Frequency
RMS	Root Mean Square
SNR	Signal to Noise Ratio
VHF	Very High Frequency

## 4 Technical requirements specifications

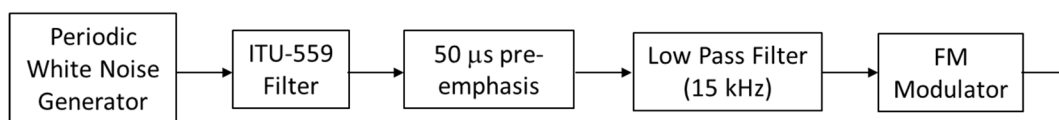
### 4.1 Test signal configurations

The generated FM signals (wanted and unwanted) and the blocking signal shall be in accordance with table 1. The configuration is based on Recommendation ITU-R BS.641 [i.5].

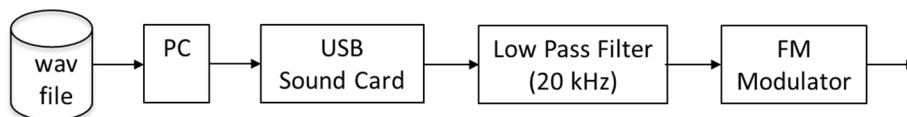
**Table 1: FM configuration**

Parameter	FM signals		AM signal
	Wanted	Unwanted	Blocking
<b>Audio modulation</b>	1 kHz tone	Weighted noise Recommendation ITU-R BS.559-2 [3], clause 1, band- limited to 15 kHz (see note 1)	1 kHz tone
<b>Other modulation parameters</b>	±60,8 kHz peak deviation	15,9 kHz RMS deviation (see note 2)	80 % depth
<b>Pilot tone</b>	None	None	
NOTE 1: The filter shall have a cut-off frequency of 15 kHz and a minimum roll-off of 60 dB/octave. NOTE 2: This is equivalent to a quasi-peak deviation of 34,8 kHz and has pre-emphasis enabled. The quasi-peak level measurement is defined by Recommendation ITU-R BS.641 [i.5], clause 5; with pre-emphasis disabled the quasi-peak deviation is 32 kHz (14,5 kHz RMS).			

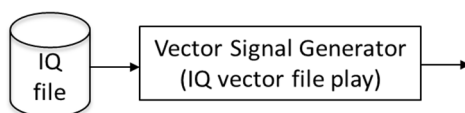
The means of generating the noise modulation for the "unwanted" signal is shown in figure 1.



a) Hardware method



b) PC sound card method



c) Vector signal generator method

NOTE: In a), the low pass filter has a cut-off frequency of 15 kHz and a minimum roll-off of 60 dB/octave; in b), the low pass filter has a cut-off frequency of 20 kHz and a minimum roll-off of 40 dB/octave.

**Figure 1: Example arrangements for generating the unwanted signal**

Waveform files to produce the signals using either the PC sound card method or the vector signal generator method are contained in archive en\_30334501v010101p0.zip which accompanies ETSI EN 303 345-1 [1]. For further details see annex B.

## 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 that the audio SNR  $\geq 40$  dBQ ref  $\pm 60,8$  kHz deviation, and that there shall be 10 seconds of audio with no subjective impairments (e.g. clicks resulting from FM threshold effects).

**Table 2: FM sensitivity requirements**

De-modulation	Tuned frequency band	Wanted signal centre frequency (MHz)	Required sensitivity limit	
			Conducted (dBm)	Radiated (dB $\mu$ V/m)
FM	VHF band II	98	-90	50 (see note)

NOTE: For products with an integral antenna, the requirement is relaxed to 67 dB $\mu$ V/m.

### 4.2.3 Conformance

Conformance tests as defined in ETSI EN 303 345-1 [1], clause 5.3.4.1 shall be carried out. 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 criteria 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 a small multiple of the adjacent channel spacing. The wanted and unwanted signals are of the same modulation type.

The blocking ratio 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 at a given frequency separation. The wanted and unwanted signals are of different modulation types.

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 = 2, 3, 4)	Unwanted frequency (blocking)
FM	VHF band II	$\pm N \times 100$ kHz	$\pm 800$ 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 criteria relevant for these tests is that the audio SNR  $\geq 40$  dBQ ref  $\pm 60,8$  kHz deviation, and that there shall be 10 seconds of audio with no subjective impairments (e.g. clicks resulting from FM threshold effects).

**Table 4: Adjacent channel selectivity and blocking requirements**

De-modulation (see note 1)	Tuned frequency band	C Wanted signal centre frequency (MHz)	C Wanted signal level		Required I/C ratio (see notes 2 and 3)			
			Conducted (dBm)	Radiated (dB $\mu$ V/m)	N = 2 (dB)	N = 3 (dB)	N = 4 (dB)	Blocking (dB)
FM (built-in or integral antenna)	VHF band II	98	n/a	56 (see note 4)	-15	-3	8	20
FM (external antenna)	VHF band II	98	-84	n/a	3	17	30	30

NOTE 1: The ACS and blocking requirements are currently separated into different limits for radiated and conducted testing methods. These limits are likely to be unified in a future revision of the present document. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

NOTE 2: The frequency of the interferer shall be calculated using the channel spacing data in table 3 for each of the 6 defined adjacent channels  $N = \{-4, -3, -2, +2, +3, +4\}$  and the two blocking offsets. Each row of table 4 thus defines 8 individual tests.

NOTE 3: The minimum level of I for the relevant level of impairment is calculated by adding the I/C ratio to the wanted C level.

NOTE 4: The wanted signal level for receivers with integral antenna is 73 dB $\mu$ V/m.

### 4.3.3 Conformance

Conformance tests as defined in ETSI EN 303 345-1 [1], clause 5.3.5.1 shall be carried out 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.

---

## 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 declared operational environmental profile.

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 declared operational environmental profile) to give confidence of compliance for the affected technical requirements.

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.

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 [i.3], in particular in annex D of ETSI TR 100 028-2 [i.4].

## 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 303 345-3					
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	Receiver adjacent channel selectivity and blocking	3.2	4.3	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".

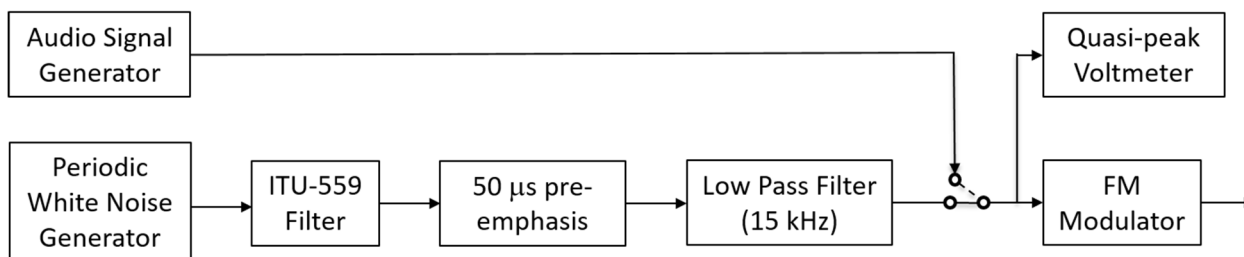
Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

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

## Annex B (informative): Test signal generation

The test signals required for the FM radio selectivity tests can be generated using analogue or digital techniques.

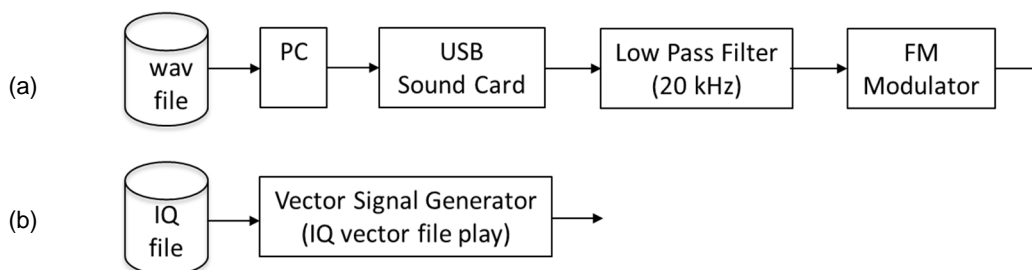
The analogue method is shown in figure B.1. An FM test signal generator is first modulated with a 500 Hz sinusoidal tone obtained from an audio signal generator. The level of the modulating signal at the input of the FM modulator is adjusted to obtain a deviation of  $\pm 32$  kHz. The audio level at the FM modulator input is measured by means of a noise voltmeter. The noise voltmeter consists of a quasi-peak voltmeter with defined dynamic characteristics (see Recommendation ITU-R BS.468-4 [2]). Any noise-weighting network is switched off. Next, the band-limited noise replaces the sinusoidal tone at the FM modulator input. The level of the noise signal at the FM modulator input is adjusted to give the same quasi-peak reading at the noise voltmeter as with the sinusoidal tone with the pre-emphasis disabled. Pre-emphasis is re-enabled for the receiver tests, which increases the level into the FM modulator by 0,7 dB.



NOTE: The low pass filter has a cut-off frequency of 15 kHz and a minimum roll-off of 60 dB/octave.

**Figure B.1: Block diagram for hardware generated test signal**

The digital methods may use a baseband audio file, as shown in figure B.2(a), or by using a vector signal generator, as shown in figure B.2(b).



NOTE: The low pass filter has a cut-off frequency of 20 kHz and a minimum roll-off of 40 dB/octave.

**Figure B.2: Block diagrams for digitally generated test signals**

Waveform files are contained in archive en\_30334501v010101p0.zip which accompanies ETSI EN 303 345-1 [1] and are detailed in table B.1.

**Table B.1: Test signal sequences**

Test signal	Description	Test signal filename	
		Baseband signal	IQ vector signal
<b>Wanted</b>	1 kHz tone, 60,8 kHz deviation	FM_Wanted.wav	FM_Wanted.wv
<b>Unwanted</b>	Recommendation ITU-R BS.559-2 [3] weighted noise (15 kHz BW limit, with pre-emphasis)	FM_Unwanted.wav	FM_Unwanted.wv
<b>Blocking</b>	1 kHz tone, 80 % peak depth	Blocking.wav	Blocking.wv
<b>Line-up</b>	Line-up signal for baseband method	FM_Line_Up.wav	-

When using the PC soundcard method, care is required to set the correct baseband level into the signal generator to achieve the required deviation of the FM carrier. The additional line-up signal can be used to align the modulation level. Modulation Auto Level Control (ALC) should be disabled, as it is likely to affect the crest factor of the Recommendation ITU-R BS.559-2 [3]weighted noise. The level of the line-up test signal should be increased from zero until the central carrier vanishes, viewed on a spectrum analyser, see figure B.3d). Replaying the wanted test signal at the same gain setting will then give the correct carrier deviation as defined in table B.2a.

**Table B.2a: Required FM deviation for baseband test sequences**

Test Signal	Filename	Level	Crest factor	Deviation	
		(dBFS)	(dB)	RMS (kHz)	Q-P (kHz)
<b>Wanted</b>	FM_Wanted.wav	-6,0	3,0	43,0	60,8
<b>Unwanted</b>	FM_Unwanted.wav	-14,7	12,3	15,9	34,8
<b>Line-up</b>	FM_Line_Up.wav	-16,0	3,0	13,6	19,2

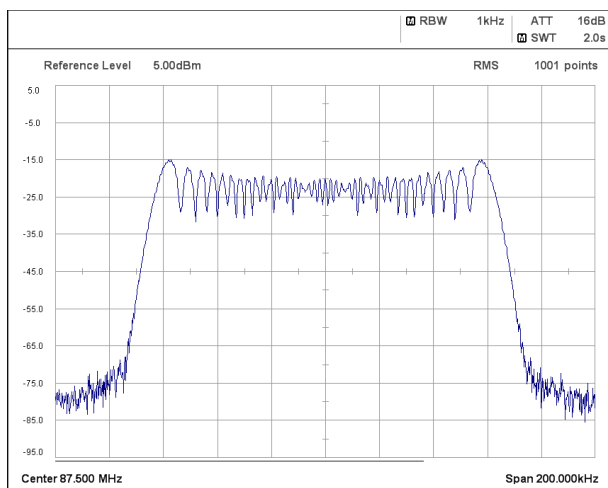
NOTE: Level is defined in accordance with AES17 [i.6].

**Table B.2b: Required AM modulation depth for baseband test sequences**

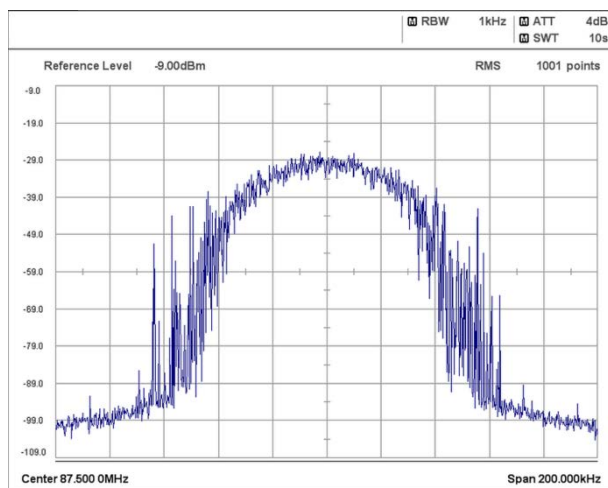
Test Signal	Filename	Level	Crest factor	AM depth	
		(dBFS)	(dB)	RMS (%)	Q-P (%)
<b>Blocking</b>	Blocking.wav	-6,0	3,0	56,6	80,0

NOTE: Level is defined in accordance with AES17 [i.6].

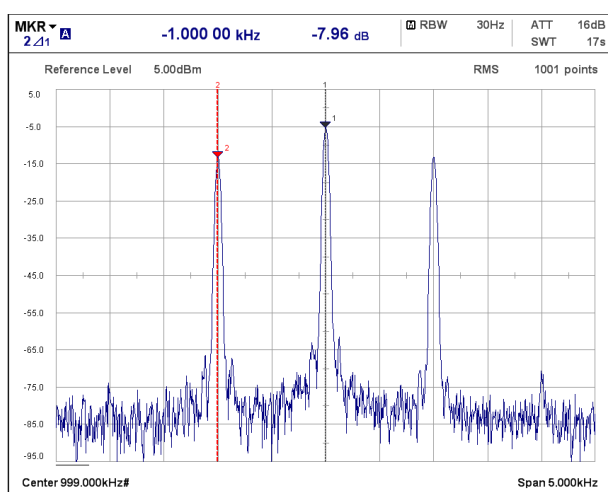
The typical RF spectra for the test signals listed in table B.1 are shown in figure B.3.



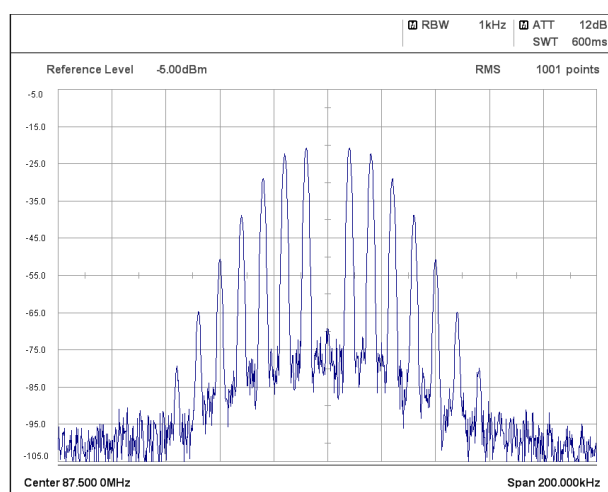
a) Wanted, 1 kHz tone, 43,0 kHz RMS deviation



b) Unwanted, ITU 559 noise, 15,9 kHz RMS deviation



c) Blocking, 1 kHz tone, 80 % AM peak depth



d) Line up, 8 kHz tone, 13,6 kHz RMS deviation

Figure B.3: Spectra of test signals



---

## Annex C (informative): Development of the present document

### C.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.

---

### C.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.

---

### C.3 Receiver parameters under article 3.2

#### C.3.1 General

Clause 5.3 of the ETSI guide, ETSI EG 203 336 [i.7], 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 FM transmissions in Europe, the GE84 agreement [i.8] is used as the basis for coordinating the locations and powers of broadcast transmitters.

#### C.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.412-9 [i.9]. As broadcast radio receivers may use either internal or external antennas, limits are specified for both radiated and conducted signals.

### C.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 the co-channel rejection performance of the receiver combined with the receiver noise figure directly affects the sensitivity performance, which is tested. The required limits for sensitivity ensure that products have the required co-channel rejection.

Broadcast planning ensures that transmission powers levels and reuse distances of the same frequency are coordinated to minimize the amount of co-channel energy.

### C.3.4 Receiver selectivity

#### C.3.4.1 General

Receiver selectivity is described in Recommendation ITU-R SM.332-4 [i.10] 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.

#### C.3.4.2 Single signal selectivity

##### C.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.  $\pm 2$ ,  $\pm 3$  and  $\pm 4$  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.412-9 [i.9]. As broadcast radio receivers may use either internal or external antennas, limits are specified for both radiated and conducted signals.

##### C.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 are relatively cheap products that have not historically suffered specifically from this issue.

#### C.3.4.3 Receiver multiple signal selectivity

##### C.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.

#### C.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.

#### C.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.

#### C.3.4.4 Other receiver effects

##### C.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.

##### C.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.

##### C.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.

### C.3.5 Receiver unwanted emissions in the spurious domain

A specific test for receiver unwanted emissions in the spurious domain is not included in the present document because, under the standardisation agreements between ESOs, the spurious emissions of broadcast receivers are tested under the EMCD remit of CENELEC; the testing is specified in CENELEC EN 55032 [i.11].

---

## Annex D (informative): Change History

Version	Information about changes
1.1.1	First published version.

---

## History

Document history		
V1.1.0	November 2019	EN Approval Procedure AP 20200203: 2019-11-05 to 2020-02-03