Final draft ETSI EN 303 345-3 V1.1.1 (2021-03)

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

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Foreword

This final 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 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, blocking and unwanted emissions in the spurious domain 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 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] 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".

[4] 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.

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] Recommendation ITU-R BS.641 (07/1986): "Determination of radio-frequency protection ratios for frequency-modulated sound broadcasting".

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

[i.5] 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.6] 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.7] Recommendation ITU-R BS.412-9 (12/1998): "Planning standards for terrestrial FM sound broadcasting at VHF".

[i.8] 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

crest factor: peak to rms voltage ratio

external antenna: antenna designed to be connected to the equipment with the use of a 50 Ω or 75 Ω external connector

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.4]

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

dBμV/m: decibels relative to 1 μV/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
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
USB	Universal Serial Bus
VHF	Very High Frequency

4 Technical requirements specifications

4.1 Test signal configurations

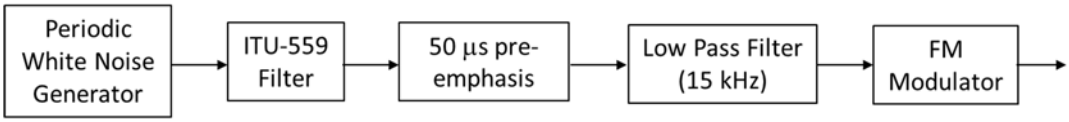
The generated FM signals (wanted and unwanted) and the blocking signal shall be in accordance with table 1. The configuration is based on Recommendation ITU-R BS.641 [i.3].

Table 1: FM configuration

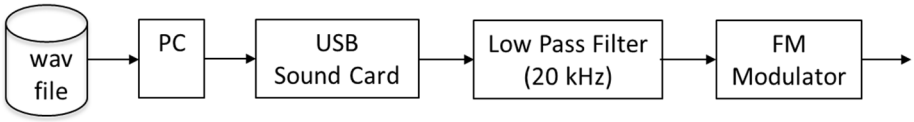
Parameter	FM signals		AM signal
	Wanted	**Unwanted**	**Blocking**
Audio modulation	1 kHz tone	Weighted noise Recommendation ITU-R BS.559-2 [3], clause 1, band-limited to 15 kHz (see note 1)	1 kHz tone
Other modulation parameters	±60,8 kHz peak deviation	15,9 kHz RMS deviation (see note 2)	80 % depth
Pilot tone	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.3], clause 5; with pre-emphasis disabled the quasi-peak deviation is 32 kHz (14,5 kHz RMS).

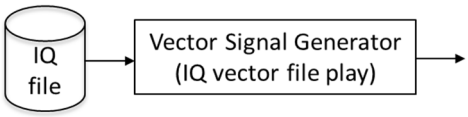
The means of generating the noise modulation for the "unwanted" signal is shown in figure 1.



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 ≥ 40 dBQ ref ±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 (dBµV/m)
FM	VHF band II	98	-90	50 (see note)
NOTE: For products with an integral antenna, the requirement is relaxed to 67 dBµV/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	±N × 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 criteria relevant for these tests is that the audio SNR ≥ 40 dBQ ref ±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 (dBµV/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 dBµV/m.