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Transmitting equipment for the Amplitude Modulated (AM) sound broadcasting service; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Reference
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Contents

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Foreword

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

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

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

National transposition dates	
Date of adoption of this EN:	27 March 2017
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Date of withdrawal of any conflicting National Standard (dow):	31 December 2018

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 the design and operation of an AM sound broadcasting service transmitter to meet the essential requirements of article 3.2 of Directive 2014/53/EU [i.1].

1 Scope

The present document specifies technical characteristics and methods of measurements for transmitter equipment for broadcast sound services using the Double Side Band amplitude modulated sound broadcasting service operating in the LF, MF and HF bands.

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.1] under the conditions identified 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.

Not applicable.

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] 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] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

broadcasting service: radiocommunication service in which the transmissions are intended for direct reception by the general public

NOTE: This service may include sound transmissions, television transmissions or other types of transmission.

carrier power: average power supplied to the antenna transmission line by a transmitter during one cycle taken under the condition of no modulation

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

class of emission: set of characteristics of an emission, designated by standard symbols, e.g. type of modulation of the main carrier, modulating signal, type of information to be transmitted, and also, if appropriate, any additional signal characteristics

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

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

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

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

harmonic: component of order greater than 1 of the Fourier series of a periodic quantity

harmonic number: integral number given by the ratio of the frequency of a harmonic to the fundamental frequency (second harmonic = 2 × fundamental frequency)

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

mean power: average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation envelope taken under normal operating conditions

necessary bandwidth: for a given class of emission, width of the frequency band which is sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions

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

reference bandwidth: bandwidth in which the spurious emission level is specified

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

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

unwanted emissions: spurious emissions and out of band emissions

3.2 Symbols

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

Ω	ohms (unit of resistance)
μ	micro, 10^{-6}

3.3 Abbreviations

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

AF	Audio Frequency
AM	Amplitude Modulation
dB	deciBel, logarithmic ratio (tenths of a "Bel")
dBm	dB relative to one milliwatt
EUT	Equipment Under Test
HF	High Frequency
LF	Low Frequency
MF	Medium Frequency
RF	Radio Frequency
V	Volt

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 manufacturer. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile.

4.2 Conformance requirements

4.2.1 Rated output power

4.2.1.1 Definition

The rated output power is the carrier power that the transmitter or transposer shall deliver at its antenna port under manufacturers specified conditions of operation.

4.2.1.2 Limit

The carrier output power shall be the rated output power under normal operating conditions as defined by the manufacturer.

4.2.1.3 Conformance

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

4.2.2 Frequency drift

4.2.2.1 Definition

The uncontrolled continuous and irreversible variation of frequency against a predetermined time scale.

4.2.2.2 Limit

For a period of not less than ninety days, the frequency of the transmitter shall stay within the tolerance of ±10 Hz.

4.2.2.3 Conformance

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

4.2.3 Spurious emissions

4.2.3.1 Definition

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

4.2.3.2 Limit

Spurious emissions shall not exceed the values set out in table 4.1, additionally shown in figure 4.1, for the frequency range 9 kHz to 1 GHz.

Table 4.1: Spurious emission limits

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

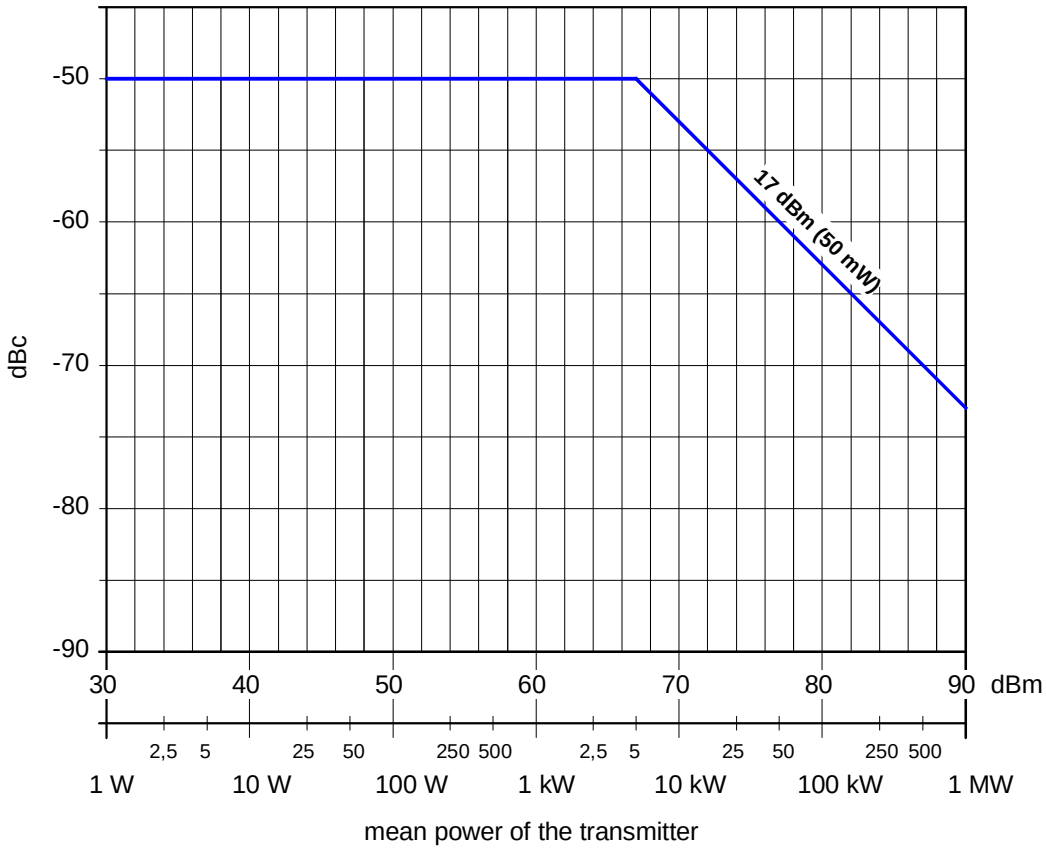


Figure 4.1: Spurious emission limits

4.2.3.3 Conformance

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

4.2.4 Transmitter muting during frequency shift

4.2.4.1 Definition

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

4.2.4.2 Limits

The muting shall be as defined in clause 4.2.3.2.

4.2.4.3 Conformance

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

4.2.5 Out-of-band emissions

4.2.5.1 Definition

Emission on a frequency or frequencies immediately outside the necessary bandwidth, which results from the modulation process, but excludes spurious emissions.

4.2.5.2 Limit

Out of band emissions shall not exceed the values set out in table 4.2. Additionally, the limits are shown in figure 4.2 on a logarithmic frequency axis and in figure 4.3 on a linear axis.

Relationship between the 0 dB reference level and the carrier level:

- The reference level 0 dB corresponds to power density that would exist if the total RF power, excluding the power of the carrier, were distributed uniformly over the necessary bandwidth.

The ratio α_B (dB) of 0 dB reference level to the carrier is given by the equation:

$$\alpha_B = 10\log\frac{m_{rms}^2}{2}\frac{B_{eff}}{F}$$

where: m_{rms} = r.m.s modulation factor of the transmitter

B_{eff} = effective noise bandwidth of the analyser

F = necessary bandwidth for the emission

Hence the reference level depends on the power of the sideband P_s, given by the formula:

$$P_s = \frac{m_{rms}^2}{2}P_c$$

where: P_c = carrier power

If frequency is plotted as the abscissa in logarithmic units and if the power densities are plotted as ordinates (dB) the curve representing the out-of-band spectrum should lie below two straight lines starting at point (0,5 *F*; 0 dB) or at point (-0,5 *F*; 0 dB) and finishing at point (0,7 *F*; -35 dB) or (-0,7 *F*; -35 dB) respectively. Beyond these points and down to the level of -60 dB, this curve should lie below two straight lines starting from the latter points and having a slope of 12 dB/octave. Thereafter, the same curve should lie below the level -60 dB. The ordinate of the curve so defined represents the average power intercepted by an analyser with an rms noise bandwidth of 100 Hz, the frequency of which is tuned to the frequency plotted on the abscissa.

Table 4.2: Out-of-band emission limits

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

NOTE: Figure 4.2 is only an additional representation of the limits given in table 4.2. It is not representative of the output of a spectrum analyser. The slope outside ±0,7 × F is 12 dB per octave until the value of -60 dB is reached.

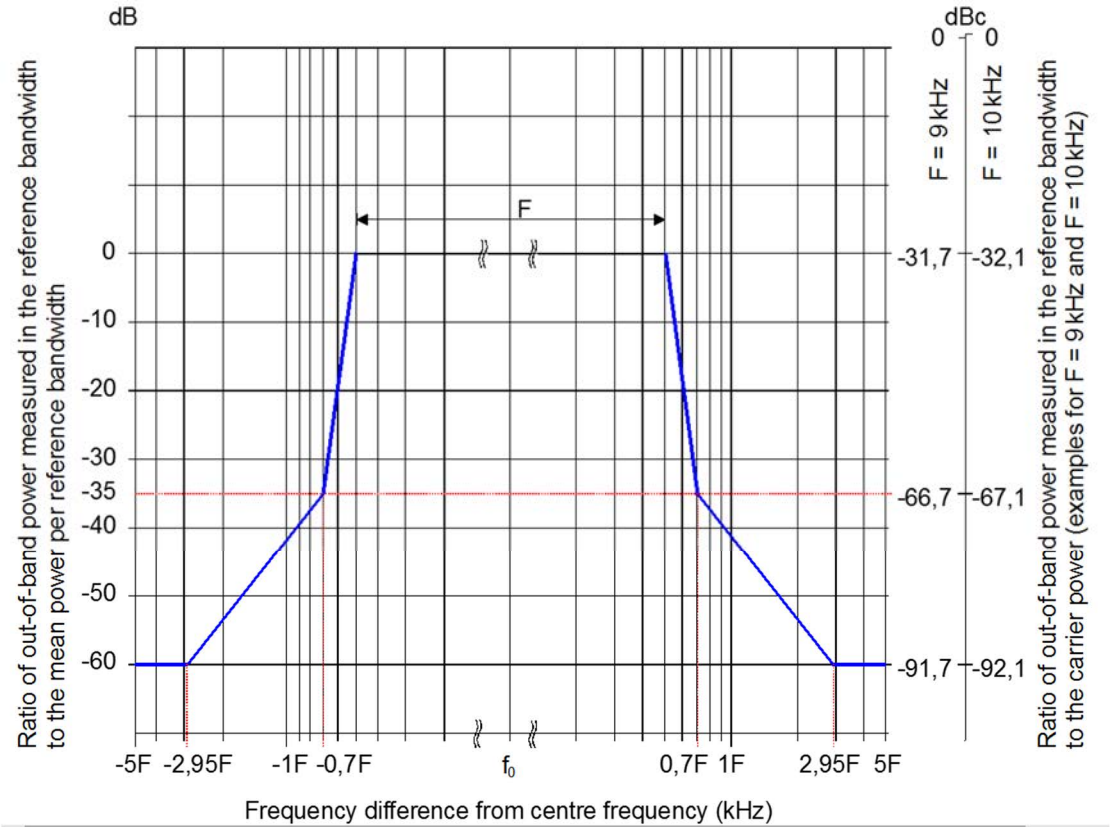


Figure 4.2: Out of band emission limits shown on a logarithmic axis

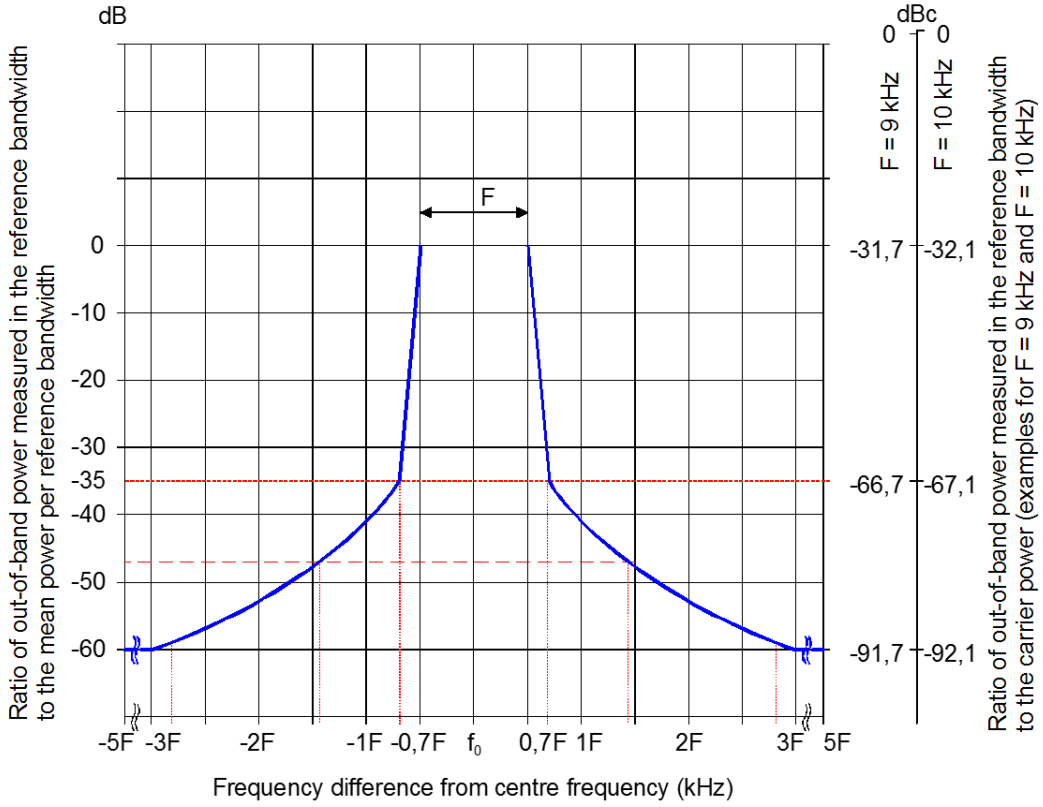


Figure 4.3: Out of band emission limits shown on a linear axis

4.2.5.3 Conformance

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

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the 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.

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 shall 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 less than the figures in table 5.1.

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 5.1 is based on such expansion factors.

Table 5.1: Maximum measurement uncertainty

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

5.3 Methods of measurement

5.3.1 Rated output power

5.3.1.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

a) the lowest operating frequency of the EUT;

b) the highest operating frequency of the EUT;

c) a frequency mid-way between a) and b) above.

Test arrangement (see figure B.1):

1) connect the EUT to the Test Load, via the Coupling Device;

2) connect the Spectrum Analyser or power meter to the Coupling Device.

The AF Signal Generator and Voltage measuring equipment are not required for this test.

5.3.1.2 Procedure

1) operate the EUT at each of the test frequencies as defined in clause 5.3.1.1;

2) measure the results on the Spectrum Analyser or power meter.

5.3.1.3 Test requirements

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

5.3.2 Frequency drift

5.3.2.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequency:

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

Test arrangement (see figure B.1):

1) connect the EUT to the Test Load, via the Coupling Device;
2) connect a frequency recorder to the Coupling Device.

The AF Signal Generator and Voltage measuring equipment are not required for this test.

5.3.2.2 Procedure

1) operate the exciter of the EUT at the test frequency as defined in clause 5.3.2.1;
2) measure the results on the frequency recorder.

Measurements should be made at intervals, which are short enough to reveal the presence of superimposed periodical variations.

5.3.2.3 Test requirements

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

5.3.3 Spurious emissions

5.3.3.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

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

Test arrangement (see figure B.1):

1) the measurement shall be done without any modulation;
2) connect the EUT to the Test Load, via the Coupling Device;
3) connect the Spectrum Analyser to the Coupling Device.

5.3.3.2 Procedure

1) terminate the input of the transmitter as specified by the manufacturer;
2) operate the EUT at each of the test frequencies as defined in clause 5.3.3.1;

3) measure the results on the Spectrum Analyser.

5.3.3.3 Test requirements

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

5.3.4 Transmitter muting during frequency shift

5.3.4.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

- present frequency to desired frequency.

Test arrangement (see figure B.1):

1) all ports unused at the time of testing shall be correctly terminated;
2) connect the EUT to the test load, via the coupling device;
3) connect the measuring device to the coupling device.

5.3.4.2 Procedure

1) operate the EUT at the present frequency;
2) initiate frequency change;
3) observe the output signal on an oscilloscope.

5.3.4.3 Test requirements

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

5.3.5 Out-of-band emissions

5.3.5.1 Initial conditions

Test environment:

- the normal operating environment, as declared by the equipment manufacturer.

Test frequencies:

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

Test arrangement (see figure B.1):

1) connect the AF Signal Generator to the EUT;
2) connect the EUT to the Test Load, via the Coupling Device;
3) connect the Spectrum Analyser to the Coupling Device.

5.3.5.2 Procedure

1) set the AF Signal Generator to deliver a test signal as defined in clause B.3;

2) operate the EUT at each of the test frequencies as defined in clause 5.3.5.1;

3) measure the results on the Spectrum Analyser: the measurement shall be repeated for at least 5 times and the results shall be averaged.

The spectrum limits described in this clause for amplitude-modulated emissions for sound broadcasting have been deduced from measurements performed on transmitters which were modulated by weighted noise to an rms modulation factor of 35 % in the absence of any dynamic compression of the signal amplitudes (see clause B.3).

5.3.5.3 Test requirements

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

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

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

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

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

Harmonised Standard ETSI EN 302 017				
Requirement			Requirement Conditionality	
No	Description	Reference: Clause No	U/C	Condition
1	Rated output power	4.2.1	U	
2	Frequency drift	4.2.2	U	
3	Spurious emissions	4.2.3	U	
4	Transmitter muting during frequency shift	4.2.4	U	
5	Out-of-band emissions	4.2.5	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 is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

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

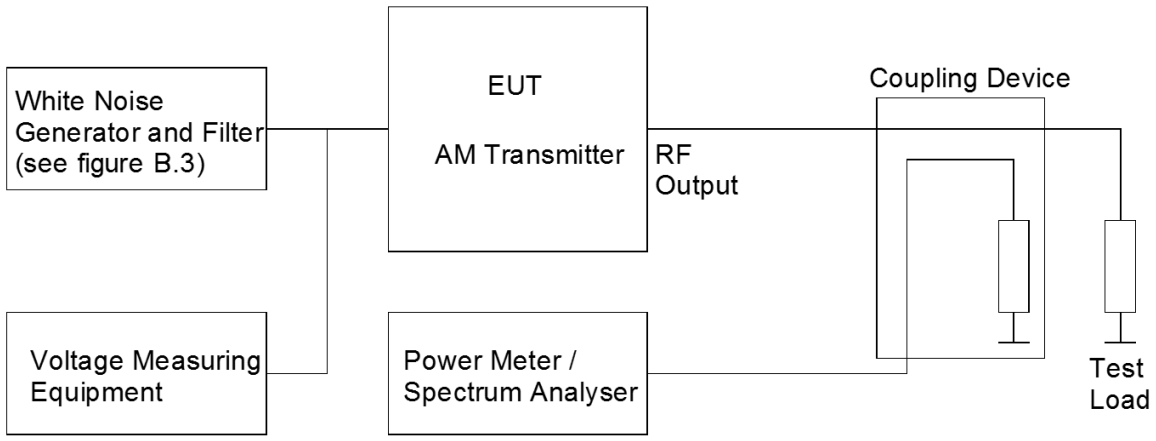
Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

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

Annex B (normative): General measuring arrangements

B.1 Testing arrangements for antenna port measurements

Figure B.1 shows the generic testing arrangement.



NOTE: In the case of spurious emissions the White Noise Generator and Filter are not used.

Figure B.1: Testing arrangement

B.2 Test frequency range

Limits on unwanted emissions for radio equipments are considered to be applicable to the range 9 kHz to 300 GHz. However, for practical measurement purposes, the frequency range of spurious emissions may be restricted. As guidance for practical purposes, the following measurement parameters in table B.1 are recommended.

Table B.1: Test frequency range

Transmitter fundamental frequency range	Unwanted emission frequency measurement range	
	Lower frequency	Upper frequency
9 kHz to 30 MHz	9 kHz	1 GHz

The following reference bandwidths shall be used:

For spurious emissions:

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

For out of band emissions:

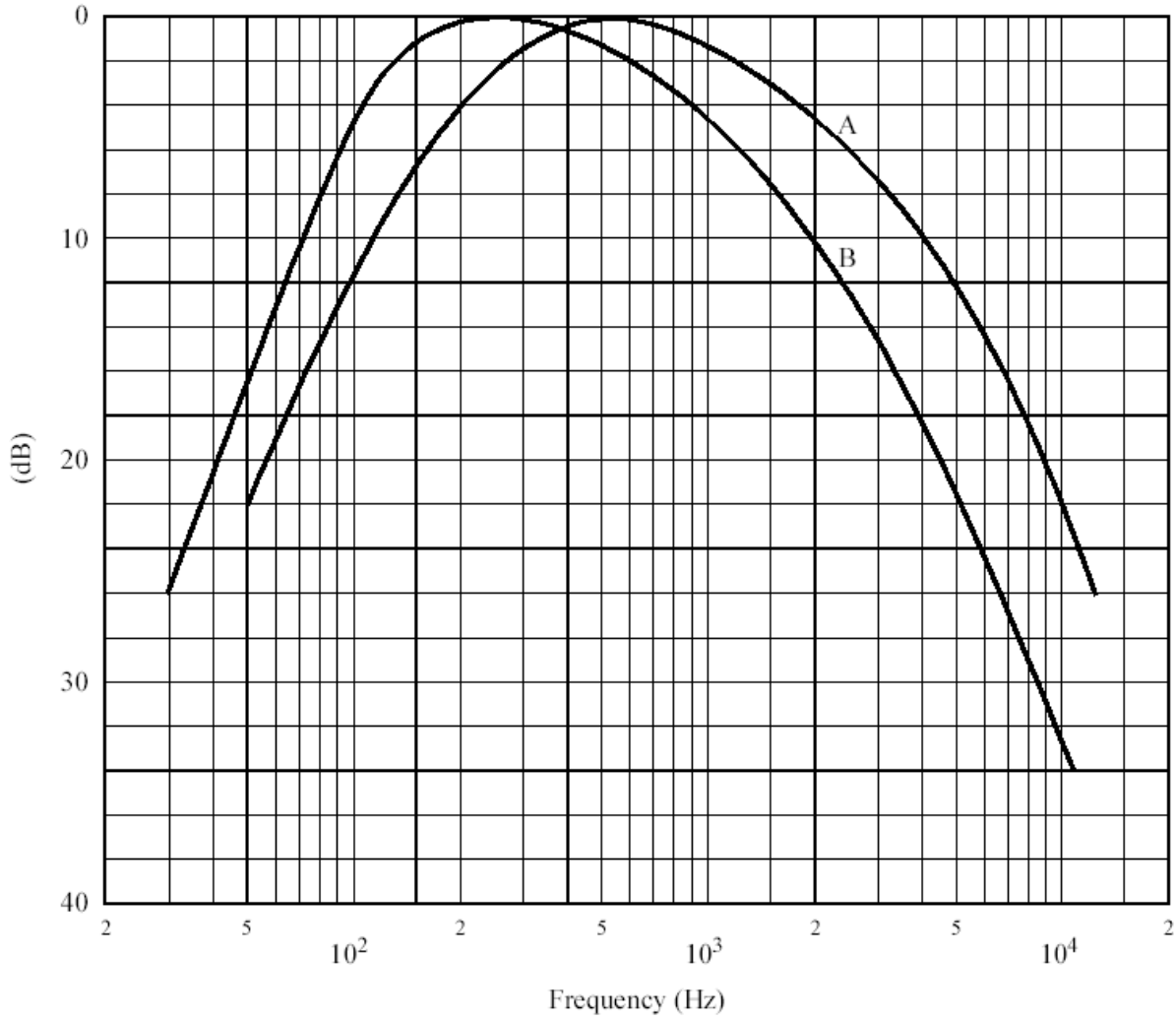
- 100 Hz.

B.3 Test modulating signal

The noise is weighted in accordance with the curves shown in figure B.2.

Two conditions shall be fulfilled by the standardized signal to simulate programme modulation:

- its spectral constitution shall correspond to that of a representative broadcast programme;
- its dynamic range shall be small enough to result in a constant unequivocal reading on the instrument.



Curves A: frequency spectrum of standardized noise (measured with one-third octave filters).
B: frequency response characteristic of filter-circuit.

Figure B.2: Coloured noise modulation

The amplitude distribution of modern dance music was taken as a basis, as it is a type of programme with a considerable proportion of high audio-frequencies, which occur most frequently. However, the dynamic range of this type of programme is too wide and does not fulfil, therefore, the second requirement mentioned above. A signal which is appropriate for this purpose is a standardized coloured noise signal, the spectral amplitude distribution of which is fairly close to that of modern dance music (see curve A of figure B.2, which is measured using one-third octave filters).

This standardized coloured noise signal may be obtained from a white-noise generator by means of a passive filter circuit as shown in figure B.3. The frequency-response characteristic of this filter is reproduced as curve B of figure B.2. It should be noted that the difference between curve A and curve B of figure B.2 is due to the fact that curve A is based on measurements with one-third octave filters which pass greater amounts of energy as the bandwidth of the filter increases with frequency.

The spectrum beyond the required bandwidth of the standardized coloured noise should be restricted by a low-pass filter having a cut-off frequency and a slope such that the bandwidth of the modulating signal is approximately equal to half the standardized bandwidth of emission. The audio-frequency amplitude/frequency characteristic of the modulating stage of the signal generator shall not vary by more than 2 dB up to the cut-off frequency of the low-pass filter.

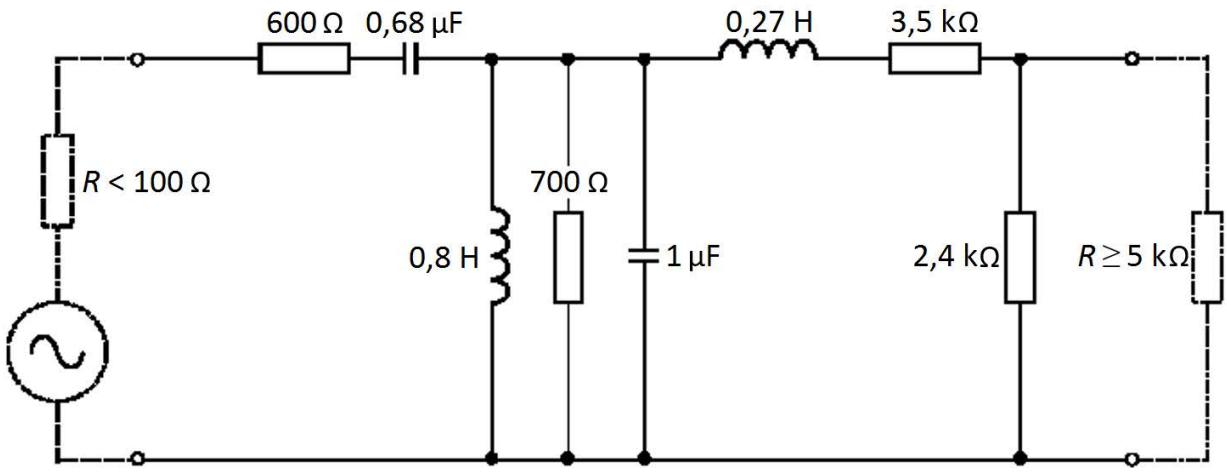


Figure B.3: White Filter circuit

B.4 Test load characteristics

The transmitter may be required to operate into a precision load with return loss of > 26 dB in the frequency band in which the transmitter is designed to operate.

Annex C (informative): Change History

Version	Information about changes
2.1.1	First published version covering Directive 2014/53/EU. Major changes are: • Removal of cabinet radiation requirements.

History

Document history		
V1.1.1	September 2005	Publication as ETSI EN 302 017 part 1 and part 2
V2.0.3	December 2016	EN Approval Procedure AP 20170326: 2016-12-26 to 2017-03-27
V2.1.1	April 2017	Publication