

# ETSI EN 301 489-15 V2.2.1 (2019-04)



**ElectroMagnetic Compatibility (EMC)  
standard for radio equipment and services;  
Part 15: Specific conditions for commercially available  
amateur radio equipment;  
Harmonised Standard covering the essential requirements  
of article 3.1(b) of Directive 2014/53/EU**

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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.

The present document is part 15 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

National transposition dates	
Date of adoption of this EN:	6 June 2017
Date of latest announcement of this EN (doa):	31 July 2019
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 January 2020
Date of withdrawal of any conflicting National Standard (dow):	31 January 2021

## 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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# 1 Scope

The present document, together with ETSI EN 301 489-1 [1], covers the assessment of commercially available amateur radio equipment, and associated ancillary equipment, in respect of ElectroMagnetic Compatibility (EMC).

Technical specifications related to the antenna port and emissions from the enclosure port of commercially available amateur radio equipment are not included in the present document. Such technical specifications are found in the relevant product standard ETSI EN 301 783 [i.2] for the effective use of the radio spectrum.

The present document specifies the applicable EMC tests, the methods of measurement, the limits and the performance criteria for radio equipment intended for use by radio amateurs within the meaning of article 1, definition 53 of the Radio Regulations [i.3] and associated ancillary equipment, which is commercially available.

Examples of amateur radio equipment covered by the present document are given in annex B.

The provisions of the present document apply to amateur radio equipment manufactured commercially either as ready-to-use equipment, modules, or components having an intrinsic functionality for the customer.

The expression "amateur radio equipment" in the context of the present document is taken to mean "commercially available amateur radio equipment" only.

In case of differences (for instance concerning special conditions, definitions, abbreviations) between the present document and ETSI EN 301 489-1 [1], the provisions of the present document take precedence.

The environment classification and the emission and immunity requirements used in the present document are as stated in ETSI EN 301 489-1 [1], except for any special conditions included in the present document. The applicable environments referred to in ETSI EN 301 489-1 [1] where equipment covered by the scope of the present document may be used, are to be declared by the manufacturer.

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## 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 301 489-1 (V2.2.0) (03-2017): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU".

### 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 EN 301 783 (V2.1.1) (01-2016): "Commercially available amateur radio equipment; Harmonised standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.3] ITU Radio Regulations (Edition of 2016).
- [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 ETSI EN 301 489-1 [1] and the following apply:

**maximum usable sensitivity:** minimum receiver Radio Frequency (RF) input signal level or field strength able to produce a specified analogue SINAD ratio or Bit Error Ratio (BER), or other specified output performance which depends on this input signal level

**multimode equipment:** amateur radio equipment capable of being used in several modes of operation, such as AM, FM, SSB

### 3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 301 489-1 [1] and the following apply:

F <sub>b</sub>	skirt bandwidth
F <sub>c</sub>	centre frequency of the transmitter necessary bandwidth
F <sub>n</sub>	necessary bandwidth

### 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 301 489-1 [1] and the following apply:

AM	Amplitude Modulation
BER	Bit Error Ratio
DSB-SC	Double SideBand-Suppressed Carrier
EMC	ElectroMagnetic Compatibility
ESD	ElectroStatic Discharge
EUT	Equipment Under Test
FM	Frequency Modulation
HF	High Frequency
PEP	Peak Envelope Power
RF	Radio Frequency
SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
SSB	Single SideBand
UHF	Ultra High Frequency
VHF	Very High Frequency

## 4 Test conditions

### 4.1 General

For the purposes of the present document, the test conditions of ETSI EN 301 489-1 [1], clause 4 shall apply as appropriate. Further product related test conditions for amateur radio and ancillary equipment are specified in the present document.

For emission and immunity tests, the test modulation, test arrangements, etc., as specified in the present document, clauses 4.1 to 4.5 of the present document shall apply.

The general test conditions for amateur radio equipment are as follows:

- transmitters and amplifiers shall be tested in stand-by (if applicable) and in transmit mode of operation;
- transceivers and transverters shall be tested in receive, stand-by, and transmit mode of operation;
- if integral antenna equipment provides an internal antenna connector for testing purposes, then the tests can be made via that connector.

The manufacturer shall recommend a power supply (e.g. an AC/DC power adapter) for use in conjunction with the equipment under test (EUT), to ensure satisfactory operation of the combination during the EMC tests. When a range of different types of power supply units can be used with several types of that manufacturer's radio equipment, then each type of power supply unit shall be tested with the radio providing the highest RF output Peak Envelope Power (PEP). These power supply units shall then be listed as preferred items for future generations of that manufacturer's radio equipment.

The EMC tests shall be performed with the EUT set to the following operation frequencies:

- single-band equipment:
  - test with the operation frequency set to the centre of the operation frequency band;
- double-band equipment:
  - test with the operation frequency set in sequence to the centre of each operation frequency band;
- HF multiband equipment or VHF/UHF multiband equipment:
  - test with the operation frequency set in sequence to the centre of the lowest, middle, and highest HF operation frequency band;
- HF/VHF, HF/UHF or HF/VHF/UHF combined equipment:
  - test with the operation frequency set in sequence to the centre of the lowest HF band, the middle HF band, the highest HF band, the lowest VHF/UHF band, the middle VHF/UHF band, and the centre of the highest VHF/UHF band.

### 4.2 Arrangements for test signals

#### 4.2.1 Arrangements for test signals at the input of transmitters

The provisions of ETSI EN 301 489-1 [1], clause 4.2.1 shall apply with the following modifications.

If possible, the transmitter should be modulated with a suitable signal, from an internal or external signal source. If it is not appropriate to get a modulated RF signal from the transmitter, then the tests may be performed using its unmodulated carrier.

It shall be possible to verify that a communications link is established and maintained.



## 4.2.2 Arrangements for test signals at the output of transmitters

The provisions of ETSI EN 301 489-1 [1], clause 4.2.2 shall apply with the following modifications.

The transmitter under test shall be modulated such that the maximum PEP output is achieved, either by single or multiple tones, or by a suitable bit stream, or in case of transmitters for other than analogue voice or data transmission, by a test modulation representative of normal use (see also clause 4.5). The manufacturer shall declare the normal test modulation.

Where thermal limitations prevent continuous transmission under such conditions, the tests may be performed using gated methods. Under these circumstances, the test method used shall be recorded in the test report.

## 4.2.3 Arrangements for test signals at the input of receivers

The provisions of ETSI EN 301 489-1 [1], clause 4.2.3 shall apply with the following modifications.

The receiver shall be provided with a wanted RF input signal chosen according to clause 4.2.3 of ETSI EN 301 489-1 [1] set to its operation frequency, and modulated with a suitable modulation signal fitting the communication system characteristics (see clause 4.5.2). If it is not appropriate to provide the receiver with a modulated wanted RF input signal, the test may be performed using an unmodulated wanted RF input signal.

If possible, the wanted RF input signal to establish a communications link shall be presented to the antenna connector by a coaxial cable. The wanted RF input signal shall be set to a nominal value of 60 dB (or a lower value as declared by the manufacturer) above the maximum usable sensitivity of the EUT, as declared by the manufacturer in the product documentation.

It shall be possible to verify that a communications link is established and maintained.

## 4.2.4 Arrangements for test signals at the output of receivers

The provisions of ETSI EN 301 489-1 [1], clause 4.2.4 shall apply.

## 4.2.5 Arrangements for testing transmitter and receiver together (as a system)

The provisions of ETSI EN 301 489-1 [1], clause 4.2.5 shall apply with the following modification.

These arrangements are only applicable for duplex transceivers. The wanted RF input signal, coupled to the receiver, shall be modulated with a suitable test signal (see clause 4.5.3). The transmitter shall be operated at its maximum PEP RF output, modulated with the test signal, coupled to the transmitter from the output of the receiver (repeater mode).

## 4.3 RF exclusion band of radio communications equipment

### 4.3.1 Exclusion band for receivers or the receiver part of transceivers

The exclusion band for a receiver and the receiver part of a transceiver is determined by the characteristics of the equipment.

For receivers operating on a fixed single frequency, the exclusion band extends from -5 % to +5 % of that fixed single operation frequency.

For receivers operating or capable of operating, on a number of spot frequencies in a narrow operating frequency band which is less than 20 % of the centre frequency of the operating band, the exclusion band extends from -5 % of the lowest frequency of the narrow operating frequency band to +5 % of the highest frequency of that band.

For receivers operating, or capable of operating on a number of spot frequencies over a wide frequency band, the exclusion band for each of the wanted RF signal test frequencies shall extend from -5 % to +5 % of each wanted RF signal test frequency.

NOTE: The exclusion bands are derived using different methodologies from those described in clause 4.3.3 of ETSI EN 301 489-1 [1]. However, the used methodologies lead to narrow exclusion bands for every amateur radio frequency band. The parameter  $n$  in the formulas derived in ETSI EN 301 489-1 [1] calculates in any case smaller than 1.

## 4.3.2 Exclusion band for transmitters or the transmitter part of transceivers

### 4.3.2.1 Exclusion band for EMC emission measurements

For EMC emission measurements, the exclusion band for transmitters shall be determined considering the class of emission characteristics of the EUT. For EMC emission measurement purposes, the bandwidth of the exclusion band shall additionally allow for the skirt bandwidth ( $F_b$ ) of the measuring instrumentation, as shown in table 1.

**Table 1: Transmitter exclusion band for emissions**

Necessary bandwidth of emission	Exclusion band	Centre of the exclusion band
$F_n < 0,05 F_c$	$3 F_n + F_b$	$F_c$
$F_n > 0,05 F_c$	$1,1 F_n + F_b$	$F_c$

Where:

- $F_n$  = necessary bandwidth of the wanted class of emission as defined in ITU Radio Regulations [i.3], clause 1.152;
- $F_b$  = 200 kHz in the frequency range below 30 MHz;
- $F_b$  = 2 MHz in the frequency range above 30 MHz;
- $F_c$  = centre frequency of the transmitter necessary bandwidth.

### 4.3.2.2 Exclusion band for immunity tests

For immunity tests, the exclusion band for transmitters extends plus and minus twice the maximum occupied bandwidth allowed for the type of service for which the equipment is intended to operate, centred around the occupied bandwidth.

NOTE: The exclusion bands are derived using different methodologies from those described in clause 4.3.2 of ETSI EN 301 489-1 [1]. However, the used methodologies lead to narrower exclusion bands for every amateur radio frequency band.

## 4.4 Narrowband responses of receivers or receivers which are part of transceivers

The provision of ETSI EN 301 489-1 [1], clause 4.4 shall apply.

## 4.5 Normal test modulation

### 4.5.1 Transmitters

For the transmitter under test, the manufacturer shall declare the normal test modulation taking due account of the following requirements:

- AM transmitters:
  - the normal modulation signal shall consist of a single sinusoidal modulation signal, causing a modulation depth to the rated value.