ETSI EN 301 783 V2.1.1 (2016-01)

**Commercially available amateur radio equipment;
Harmonised Standard covering the essential requirements
of article 3.2 of the Directive 2014/53/EU**

Reference
REN/ERM-TG26-139

Keywords
amateur, EMC, mobile, radio, service

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

Contents

Intellectual Property Rights 5
Foreword 5
Modal verbs terminology 5
1 Scope 6
2 References 6
2.1 Normative references 6
2.2 Informative references 6
3 Definitions, symbols and abbreviations 7
3.1 Definitions 7
3.2 Symbols 7
3.3 Abbreviations 7
4 General and operational requirements 7
4.1 Environmental profile 7
4.2 EUT test frequencies 7
4.3 Test power source 8
4.3.0 General requirements 8
4.3.1 Mains voltage 8
4.3.2 Regulated lead-acid battery power sources used on vehicles 8
4.3.3 Other power sources 8
4.4 Testing of equipment that does not have an external 50 Ω RF connector (integral antenna equipment) 8
4.5 Test load (artificial antenna) 8
4.6 PEP 8
4.7 Transmitter automatic shut-off facility 9
4.8 Arrangement for analogue test signals at the input of the transmitter 9
4.9 Arrangement for test signals at the input of the receiver 9
4.10 Characteristics of test signals at the input of the receiver 9
4.11 Characteristics of test signals at the input of the transmitter 9
4.11.0 General requirements 9
4.11.1 Analogue signals 10
4.11.2 Digital signals 10
4.12 Reference bandwidths for spurious measurements 10
4.13 Transmit exclusion bandwidths for spurious measurements 10
4.14 Interpretation of the measurement results 11
5 Technical requirements - Transmitters 11
5.1 Maximum power (PX) (conducted) 11
5.1.0 General requirement 11
5.1.1 Definition 11
5.1.2 Method of measurement 11
5.2 Unwanted emissions in the spurious domain 12
5.2.1 Definition 12
5.2.2 Method of measurement 12
5.2.2.1 Method of measuring conducted spurious emissions with an artificial antenna 12
5.2.2.2 Method of measuring the effective radiated power with an external antenna connector 12
5.2.2.3 Method of measuring the effective radiated power with an integral antenna 13
5.2.3 Limits 13
5.3 Spurious radiations 14
5.3.1 Definition 14
5.3.2 Methods of measurement 15
5.3.2.1 Method of measuring the power level in a specified load 15
5.3.2.2 Method of measuring the effective radiated power 15
5.3.2.3 Method of measuring the effective radiated power 16
5.3.3 Limits 16
6 Technical requirements - Receivers 16
6.1 Maximum usable sensitivity 16

6.1.1 Definition 16
6.1.2 Method of measurement 17
6.1.2.1 Amplitude modulation AM 17
6.1.2.2 Single sideband modulation SSB 17
6.1.2.3 Frequency modulation FM 17
6.1.2.4 Other types of modulation 17
6.1.3 Limits 17
6.2 Adjacent channel selectivity 17
6.2.1 Definition 17
6.2.2 Method of measurement 17
6.2.2.1 Amplitude modulation AM 17
6.2.2.2 Single sideband modulation SSB 18
6.2.2.3 Frequency modulation FM 18
6.2.2.4 Other types of modulation 18
6.2.3 Limits 18
6.3 Conducted RF immunity 18
6.3.1 Definition 18
6.3.2 Method of measurement 19
6.3.2.1 Method of measurement (analogue) 19
6.3.2.2 Method of measurement (digital) 19
6.3.2.3 Unwanted signal parameters (analogue and digital) 20
6.3.3 Limit 20

Annex A (normative): Relationship between the present document and the essential requirements of Directive 2014/53/EU 21

History 22

Intellectual Property Rights

IPRs essential or potentially essential to the present document 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.

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 in reply to the Commission's standardisation request Commission Implementing Decision C(2015) 5376 final of 04.08.2015 to provide a 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.

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:	18 December 2015
Date of latest announcement of this EN (doa):	31 March 2016
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 September 2016
Date of withdrawal of any conflicting National Standard (dow):	30 September 2017

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.

1 Scope

The present document applies to the following radio equipment types:

- Radio equipment intended to be used by radio amateurs within the meaning of article 1, definition 53, of the International Telecommunications Union (ITU) Radio Regulations [1] and which is available commercially.

NOTE: This sort of equipment is traditionally supplied with an antenna connector.

The present document also specifies technical characteristics, methods of measurement and required test results.

The present document contains requirements to demonstrate that "... *Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference*" [i.5].

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the Radio Equipment Directive [i.5] may apply to equipment within the scope of the present document.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

[1] ITU Radio Regulations (2012).

[2] ETSI TS 103 052 (V1.1.1) (03-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

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] Recommendation ITU-R SM.329-10 (2003): "Unwanted emissions in the spurious domain".

[i.2] CEPT/ERC/Recommendation 74-01 (2011): "Unwanted emissions in the spurious domain".

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

[i.4] Standardisation request M/536: "Commission implementing decision 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.5] 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.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Single SideBand (SSB): any emission using Single SideBand (SSB) suppressed carrier format

3.2 Symbols

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

Bn	Necessary bandwidth of an emission
PX	Maximum PEP

3.3 Abbreviations

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

AM	Amplitude Modulation (A3E)
CBW	Channel BandWidth
CSP	Channel SPacing
DC	Direct Current
EUT	Equipment Under Test
FM	Frequency Modulation (F3E)
HF	High Frequency
ITU-R	International Telecommunication Union, Radiocommunications sector
PEP	Peak Envelope Power
RBW	Resolution BandWidth
RF	Radio Frequency
SINAD	(Signal + Noise + Distortion) / (Noise + Distortion)
SSB	Single SideBand (J3E)
Tx	Transmit
UHF	Ultra High Frequency
VHF	Very High Frequency

4 General and operational requirements

4.1 Environmental profile

The environmental profile for operation of the equipment shall be declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the required operational environmental profile.

4.2 EUT test frequencies

Testing shall be performed with the EUT set to frequencies as follows:

- single-band equipment: test at the centre of the band;
- double-band equipment: test at the centre of both bands;
- HF multi-band equipment or VHF/UHF multi-band equipment: test at the centre of the lowest, the centre of the middle, and the centre of the highest band;

- HF/VHF, HF/UHF or HF/VHF/UHF combined equipment: test at the centre of the lowest HF band, the centre of the middle HF band, the centre of the highest HF band, the centre of the lowest VHF/UHF band, the centre of the middle VHF/UHF band, and the centre of the highest VHF/UHF band.

4.3 Test power source

4.3.0 General requirements

During testing the power source of the equipment shall be replaced by a test power source capable of producing the nominal supply voltage for the equipment as declared by the manufacturer. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

For battery operated equipment the battery shall be removed and the test power source shall be applied as close to the battery terminals as practicable.

During tests of DC powered equipment the power source voltages shall be maintained within a tolerance of < ±1 % relative to the voltage at the beginning of each test. The value of this tolerance is critical for power measurements, using a smaller tolerance will provide better measurement uncertainty values.

4.3.1 Mains voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of the test power source corresponding to the ac mains shall be between 49 Hz and 51 Hz.

4.3.2 Regulated lead-acid battery power sources used on vehicles

When the radio equipment is intended for operation from the usual types of regulated lead-acid battery power source used on vehicles the normal test voltage shall be 1,1 times the nominal voltage of the battery (for nominal voltages of 6 V and 12 V, these are 6,6 V and 13,2 V respectively).

4.3.3 Other power sources

For operation from other power sources or types of battery (primary or secondary), the normal test voltage shall be that declared by the equipment manufacturer.

4.4 Testing of equipment that does not have an external 50 Ω RF connector (integral antenna equipment)

Where equipment has an internal 50 Ω connector it shall be permitted to perform the tests at this connector.

Equipment may also have a temporary internal 50 Ω connector installed for the purposes of testing.

No connection shall be made to any internal permanent or temporary antenna connector during the performance of radiated emissions measurements, unless such action forms an essential part of the normal intended operation of the equipment, as declared by the manufacturer.

4.5 Test load (artificial antenna)

For conducted measurements of the transmitter, a power attenuator ("artificial antenna") shall be used, exhibiting a substantially non-reactive, non-radiating load of 50 Ω to the antenna connector and capable of dissipating the transmitter output power.

4.6 PEP

The PEP is the average power in watts supplied to the artificial antenna by a transmitter during one RF cycle at the highest crest of the modulation envelope. For practical purposes the methods of measurements in clause 5.1 should be used.

4.7 Transmitter automatic shut-off facility

If the equipment is fitted with an automatic transmitter shut-off facility it shall be made inoperative for the duration of the type test, unless it has to be left operative to protect the equipment.

4.8 Arrangement for analogue test signals at the input of the transmitter

For the purpose of the present document, in the case of analogue equipment, the transmitter audio frequency modulation signal shall be applied to the terminals of the audio input connector with any microphone disconnected, unless otherwise stated.

4.9 Arrangement for test signals at the input of the receiver

RF test signal sources which are applied to the receiver shall present an impedance of 50 Ω to the receiver input. This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The levels of the test signals shall be expressed in terms of the emf at the receiver input connector.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

4.10 Characteristics of test signals at the input of the receiver

Wanted RF test signals applied to the receiver shall have the modulation characteristics as specified in table 1.

Table 1: Wanted test signal

Mode	Units	Modulation
AM	60	% AM (1 kHz)
FM	60	% of the maximum permissible frequency deviation (1 kHz)
SSB	1 kHz offset	None
Other modes	as declared by the manufacturer	as declared by the manufacturer

Table 2: Unwanted test signal

Mode	Units	Modulation
AM	60	% AM (400 Hz)
FM	60	% of the maximum permissible frequency deviation (400 Hz)
SSB	Offset specified by test	None
Other modes	as declared by the manufacturer	as declared by the manufacturer

4.11 Characteristics of test signals at the input of the transmitter

4.11.0 General requirements

The manufacturer shall declare details of the modulation scheme used and identify how the percentage modulation can be measured or specified.

Equipment capable of transmission of digital information shall be tested with modulation as specified in clause 4.11.2. Equipment using analogue transmission shall be tested with modulation as specified in clause 4.11.1. Equipment capable of both analogue and digital transmission shall be tested separately in each mode.

4.11.1 Analogue signals

For tests on analogue equipment via the audio input socket terminals, the test signal shall consist of two equal amplitude non harmonically related sinusoidal input signals selected to be in the range 500 Hz to 3 kHz with at least 500 Hz separation between them, each of which would independently drive the transmitter into its compression region. The composite signal level shall be 20 dB higher than the level which produces 60 % modulation unless the output power at this drive level is less than the highest Tx output power in which case the signal level shall be set to produce the highest possible Tx output power.

For tests via any facilities sockets this test signal shall be of the nature described by the manufacturer for the purpose of the socket, at a level which produces the largest value of output power (PEP) possible with analogue modulation.

4.11.2 Digital signals

For tests on digital equipment (including digital speech), the test signal be as declared by the manufacturer, at the appropriate data rate.

If the transmission of a continuous bit stream is not possible, the test signal shall be trains of correctly coded bits or messages.

For the purpose of testing PX in clause 5.1 the test signal shall produce the largest value of output power (PEP) possible with digital modulation. If this is not the case then a test signal that does produce the largest possible value of output power (PEP) with digital modulation should be used in the testing in clause 5.1.

For digital equipments that support adaptive rates, testing is only required at one bit rate. For transmitter tests in this clause this would normally be the highest bit-rate supported by the equipment.

4.12 Reference bandwidths for spurious measurements

The reference bandwidths applicable for all spurious measurement are given in table 3.

Table 3: Reference bandwidths to be used for the measurement of spurious emissions

Frequency range	RBW
9 to 150 kHz	1 kHz
150 kHz to 30 MHz	10 kHz
30 MHz to 1 GHz	100 kHz
Above 1 GHz	1 MHz

4.13 Transmit exclusion bandwidths for spurious measurements

When measuring transmit spurious emissions, an exclusion band centred on the wanted carrier is defined as 250 % of the CSP. The minimum values of necessary bandwidth (Bn) applicable depend on the operating frequency of the equipment as defined in CEPT/ERC/Recommendation 74-01 [i.2]. The combination of 250 % of the CSP and these necessary bandwidths result in the following transmit exclusion bands for spurious measurements in table 4.

Table 4: Transmit exclusion bands for the measurement of spurious emissions

Operating freq	Bn minimum	Tx exclusion band
Below 30 MHz	4 kHz	10 kHz
30 MHz to 1 GHz	25 kHz	62,5 kHz
1 GHz to 26 GHz	100 kHz	250 kHz
Above 26 GHz	1 MHz	2,5 MHz

Where the necessary bandwidth of the emission being measured is greater than the minimum values given in table 4, the transmit exclusion band shall be recalculated using the actual value of Bn.

4.14 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 equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 5.

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 the ETSI TR 100 028-2 [i.3].

Table 5 is based on such expansion factors.

Table 5: Maximum values of absolute measurement uncertainties

Parameter	Uncertainty
Radio Frequency	±1 x 10^{-7}
RF Power (up to 160 W)	±0,75 dB
Radiated RF power	±6 dB
Conducted spurious emission of transmitter valid up to 12,75 GHz	±4 dB
Conducted spurious emission of receiver, valid up to 12,75 GHz	±7 dB
Two-signal measurement, valid up to 4 GHz	±4 dB
Radiated emission of the transmitter, valid up to 4 GHz	±6 dB
Radiated measurement of receiver, valid up to 4 GHz	±6 dB
NOTE: Valid up to 1 GHz for the RF parameters unless otherwise stated.	

5 Technical requirements - Transmitters

5.1 Maximum power (PX) (conducted)

5.1.0 General requirement

This measurement shall apply only to equipment with an external 50 Ω antenna connector.

NOTE: PEP measurement is used as a figure of merit; however, it is accepted that for digital modulation the average power is often a more useful parameter.

5.1.1 Definition

The PX of the transmitter is the maximum value of the output PEP for any condition of modulation.

The rated maximum power of the transmitter is that declared by the manufacturer.

5.1.2 Method of measurement

For non-constant envelope modulation equipment, the appropriate test modulation as specified in clause 4.11 shall be applied at the transmitter. For constant envelope modulation schemes it is not required to apply modulation. The modulation used, if any, shall be recorded in the test report.

The transmitter shall be connected to a 50 Ω power attenuator, and the PEP delivered shall be measured. The measuring instrument shall have a measurement bandwidth not less than sixteen times the CBW.

The power measured is recorded as the value PX.

5.2 Unwanted emissions in the spurious domain

5.2.1 Definition

Spurious emissions are emissions 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.

For the purpose of the present document the transition point between spurious emissions domain and the out of band emissions domain is taken as 250 % of the CSP (see Recommendation ITU-R SM.329-10 [i.1]). Furthermore, the minimum necessary bandwidths applicable to amateur radio are given by CEPT/ERC/Recommendation 74-01 [i.2] (see clause 4.13).

5.2.2 Method of measurement

5.2.2.1 Method of measuring conducted spurious emissions with an artificial antenna

This method shall apply only to equipment with an external 50 Ω antenna connector.

Spurious emissions shall be measured as the mean power level of any signal delivered into a 50 Ω load. This may be done by connecting the transmitter output through an attenuator to either a spectrum analyser (see also annex B) or selective voltmeter or by monitoring the relative levels of the spurious signals delivered to an artificial antenna (see clause 4.5).

The transmitter shall be modulated with the same test signal as used in clause 5.1 and the measurements made over the frequency range 150 kHz to 4 GHz.

For equipment operating on frequencies above 470 MHz the measurements shall also be performed over the frequency range 4 GHz to 12,75 GHz if emissions are detected within 10 dB of the of the specified limit between 1,5 GHz and 4 GHz. If the operating frequency of the EUT is greater than 6,375 GHz, the measurement frequency range shall extend up to and including twice the maximum operating frequency.

The measurements are performed excluding the transmit exclusion band centred on the frequency on which the transmitter is intended to operate (see clause 4.13).

The resolution bandwidth of the measuring receiver should be equal to the reference bandwidth as given in clause 4.12.

The measurement shall be repeated with the transmitter in the "stand-by" position.

5.2.2.2 Method of measuring the effective radiated power with an external antenna connector

This method shall apply only to equipment with an external antenna connector.

On a test site, selected from ETSI TS 103 052 [2], the equipment shall be placed at the specified height on a non-conducting support.

The transmitter antenna connector shall be connected to an artificial antenna (see clause 4.5).

The output of the test antenna shall be connected to a measuring receiver.

The test antenna shall be orientated for vertical polarization and the length of the test antenna shall be chosen to correspond to the instantaneous frequency of the measuring receiver.

The transmitter shall be modulated with same test signal as used in clause 5.1 and the measurements made over the frequency range 30 MHz to 4 GHz.

For equipment operating on frequencies above 470 MHz the measurements shall also be performed over the frequency range 4 GHz to 12,75 GHz if emissions are detected within 10 dB of the of the specified limit between 1,5 GHz and 4 GHz. If the operating frequency of the EUT is greater than 6,375 GHz, the measurement frequency range shall extend up to and including twice the maximum operating frequency.

The measurements are performed excluding the transmit exclusion band centred on the frequency on which the transmitter is intended to operate (see clause 4.13).

The resolution bandwidth of the measuring receiver should be equal to the reference bandwidth as given in clause 4.12.

The transmitter shall be switched and the measuring receiver shall be tuned over the frequency range 30 MHz to 4 GHz. At each frequency at which a discrete spurious component is detected, the test antenna shall be raised and lowered through the specified range of heights until a maximum signal level is detected on the measuring receiver.

The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.

The measuring receiver shall measure the mean power and this power shall be noted. The horizontal and vertical orientation of the antenna shall also be noted.

The transmitter shall be replaced by a substitution antenna as defined in ETSI TS 103 052 [2].

The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the spurious component detected.

The substitution antenna shall be connected to a calibrated signal generator.

The frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected.

The input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary.

The test antenna shall be raised and lowered through the specified range of heights to ensure that the maximum signal is received.

The input signal to the substitution antenna shall be adjusted to the level that produced a level detected by the measuring receiver, that is equal to the level noted while the spurious component was measured, corrected for the change of input attenuator setting of the measuring receiver.

The input level to the substitution antenna shall be recorded as power level.

The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

The measure of the effective radiated power of the spurious components is the larger of the two power levels recorded for each spurious component at the input to the substitution antenna, corrected for the gain of the antenna if necessary.

The measurement shall be repeated with the transmitter in the "stand-by" position.

5.2.2.3 Method of measuring the effective radiated power with an integral antenna

This method applies only to equipment without an external 50 Ω antenna connector.

The method of measurement shall be performed according to clause 5.2.2.2, except that the transmitter output shall be connected to the integral antenna and not to an artificial antenna.

5.2.3 Limits

The power of any spurious emission, occurring outside the exclusion band centred on the frequency on which the transmitter is intended to operate, shall not exceed the values given in tables 6 and 8 with the transmitter operating and tables 7 and 9 with the transmitter in standby mode.

Table 6: Antenna port limits in transmit mode

Frequency range or operating mode	Test Limits	Remarks
Mobile SSB equipment	-43 dBc	
Below or equal to 30 MHz	-(43 + 10 x log(PEP)) or -50 dBc whichever is higher	
Above 30 MHz	-(43 + 10 x log(PEP)) or -70 dBc whichever is higher	(see note)
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

Table 7: Antenna port limits in transmit standby mode

Frequency Range	Test Limits	Remarks
0,15 MHz to 1 000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	(see note)
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

Where limits are stated using dBc, the reference level is PX, measured at the antenna port according to clause 5.1.

Table 8: Enclosure port limits in transmit mode

Frequency range or operating mode	Test Limits	Remarks
Mobile SSB equipment	-43 dBc	
Below or equal to 30 MHz	-(43 + 10 x log(PEP)) or -50 dBc whichever is higher	
Above 30 MHz	-(43 + 10 x log(PEP)) or -70 dBc whichever is higher	(see note)
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

Table 9: Enclosure port limits in transmit standby mode

Frequency Range	Test Limits	Remarks
30 MHz to 1 000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	(see note)
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

Where limits are stated using dBc, the reference level is PX, measured at the antenna port according to clause 5.1.

5.3 Spurious radiations

5.3.1 Definition

Spurious radiations from the receiver are components at any frequency, radiated by the equipment and antenna.

For equipment with an external 50 Ω antenna connector, the levels of spurious radiations are considered to be either:

a) their power level in a specified load (conducted spurious emission); and

b) their effective radiated power when radiated by the cabinet and structure of the equipment (cabinet radiation).

For equipment without an external antenna connector, spurious radiations are considered to be their effective radiated power when radiated by the cabinet and the integral antenna, in the case of handportable equipment fitted with such an antenna and no external RF connector.

5.3.2 Methods of measurement

5.3.2.1 Method of measuring the power level in a specified load

For digital equipment that supports adaptive rates, testing is only required at the maximum bit rate that the manufacturer declares is compliant to the present document.

This method applies only to equipment with an external 50 Ω antenna connector.

Spurious radiations shall be measured as the power level of any discrete signal at the input terminals of the receiver. The receiver input terminals are connected to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω and the receiver switched on.

If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator.

For equipment operating on frequencies above 470 MHz the measurements shall also be performed over the frequency range 4 GHz to 12,75 GHz if emissions are detected within 10 dB of the of the specified limit between 1,5 GHz and 4 GHz. If the operating frequency of the EUT is greater than 6,375 GHz, the measurement frequency range shall extend up to and including twice the maximum operating frequency.

At each frequency at which a spurious component is detected, the power level shall be recorded as the spurious level delivered into the specified load.

5.3.2.2 Method of measuring the effective radiated power

For digital equipment that supports adaptive rates, testing is only required at the maximum bit rate that the manufacturer declares is compliant to the present document.

This method applies only to equipment having an external antenna connector.

In the case of radiated measurements for handportable stations, the following conditions shall apply:

- internal integral antenna: the normal antenna shall be connected;
- external antenna connector: an artificial load shall be connected to the connector for the test.

The measurement procedure shall be as follows:

a) A test site which fulfils the requirements for the specified frequency range of this measurement shall be used (see ETSI TS 103 052 [2]).

   The equipment shall be placed at the specified height on a non-conducting support and in the position closest to normal use as declared by the manufacturer.

b) The receiver antenna connector shall be connected to an artificial antenna (see clause 4.5):

   - the test antenna shall be orientated for vertical polarization and the length of the test antenna shall be chosen to correspond to the instant frequency of the measuring receiver;
   - the output of the test antenna shall be connected to a measuring receiver.

c) Radiation of any spurious components shall be detected by the test antenna and receiver, over the frequency range 30 MHz to 4 GHz. For equipment operating on frequencies above 470 MHz the measurements shall also be performed over the frequency range 4 GHz to 12,75 GHz if emissions are detected within 10 dB of the of the specified limit between 1,5 GHz and 4 GHz. If the operating frequency of the EUT is greater than 6,375 GHz, the measurement frequency range shall extend up to and including twice the maximum operating frequency.

d) At each frequency at which a component is detected the test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.

   The receiver shall then be rotated through 360° in the horizontal plane until the maximum signal level detected by the measuring receiver.

   The maximum signal level detected by the measuring receiver shall be noted.

e) The receiver shall be replaced by a substitution antenna as defined in ETSI TS 103 052 [2].

The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the spurious component detected.

f) The substitution antenna shall be connected to a calibrated signal generator.

The frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected.

g) The input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver if necessary.

h) The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.

The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the spurious component was measured, corrected for the change of input attenuator setting of the measuring receiver.

The input level of the substitution antenna shall be recorded as a power level, corrected for the change of input attenuator setting of the measuring receiver.

i) The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

j) The measure of the effective radiated power of the spurious components is the larger of the two power levels recorded for each spurious component at the input to the substitution antenna, corrected for the gain of the antenna if necessary.

5.3.2.3 Method of measuring the effective radiated power

For digital equipment that supports adaptive rates, testing is only required at the maximum bit rate that the manufacturer declares is compliant to the present document.

This method applies only to equipment without an external antenna connector.

The method of measurement shall be performed according to clause 5.4.2.2, except that the equipment and its antenna shall be mounted in a normal installation in its normal operating position.

5.3.3 Limits

The power of any spurious radiations shall not exceed the values given in table 10.

Table 10: Antenna port and enclosure port limits in receive mode

Frequency Range	Test Limits	Remarks
0,15 MHz to 1 000 MHz	-57 dBm	
> 1 000 MHz	-47 dBm	(see note)
NOTE: For measurement at frequencies greater than 40 GHz no test limits are specified.		

6 Technical requirements - Receivers

6.1 Maximum usable sensitivity

6.1.1 Definition

The maximum usable sensitivity is the minimum level of a radio frequency input signal with specified modulation which will produce at the receiver analogue outputs a chosen value of Signal plus Noise plus Distortion to Noise plus Distortion (SINAD) ratio.

In the case of digital outputs it is the minimum level of a radio frequency input signal with specified modulation which will produce a chosen value of bit error ratio.

6.1.2 Method of measurement

6.1.2.1 Amplitude modulation AM

The test input signal to the receiver shall be the normal test signals specified in clause 4.10.

The test shall be performed on frequencies as defined in clause 4.2.

For each test the input level of the test signal shall be adjusted until the SINAD ratio at the receiver output is 12 dB.

6.1.2.2 Single sideband modulation SSB

The test input signal to the receiver shall be the normal test signals specified in clause 4.10.

The test shall be performed on frequencies as defined in clause 4.2.

For each test the input level of the test signal shall be adjusted until the SINAD ratio at the receiver output is 12 dB.

6.1.2.3 Frequency modulation FM

The test input signal to the receiver shall be the normal test signals specified in clause 4.10.

The test shall be performed on frequencies as defined in clause 4.2.

For each test the input level of the test signal shall be adjusted until the SINAD ratio at the receiver output is 12 dB.

6.1.2.4 Other types of modulation

The test input signal to the receiver shall be the normal test signals specified in clause 4.10.

The test shall be performed on frequencies as defined in clause 4.2.

For each test the input level of the test signal shall be adjusted until the receive functionality as declared by the manufacturer is attained.

6.1.3 Limits

The maximum usable sensitivity shall be equal or greater the values given in table 11.

Table 11: Maximum usable sensitivity

Frequency range	AM	SSB	FM	Other
Up to 3 MHz	+16 dBµV	+10 dBµV	n/a	As declared by manufacturer
3 MHz to 30 MHz	+6 dBµV	+0 dBµV	+0 dBµV	As declared by manufacturer
30 MHz to 1 GHz	0 dBµV	-6 dBµV	-6 dBµV	As declared by manufacturer
Above 1 GHz	0 dBµV	-6 dBµV	-6 dBµV	As declared by manufacturer

6.2 Adjacent channel selectivity

6.2.1 Definition

Adjacent signal selectivity is defined as the ability of the receiver to discriminate between a wanted signal (to which the receiver is tuned) and unwanted signals existing simultaneously in channels adjacent to that of the wanted signal.

6.2.2 Method of measurement

6.2.2.1 Amplitude modulation AM

The test input signal to the receiver shall be the normal test signals specified in clause 4.10. The arrangements for applying two test signals to the receiver input, shall be according to clause 4.9.

The test shall be performed on frequencies as defined in clause 4.2.

An unwanted second signal shall be applied at a frequency offset by 250 % of the necessary bandwidth from the wanted signal. For each test the level of the unwanted signal shall be adjusted until the SINAD ratio at the receiver output is reduced from 12 dB SINAD to 6 dB SINAD.

6.2.2.2 Single sideband modulation SSB

The test input signal to the receiver shall be the normal test signals specified in clause 4.10. The arrangements for applying two test signals to the receiver input, shall be according to clause 4.9.

The test shall be performed on frequencies as defined in clause 4.2.

An unwanted second signal shall be applied at a frequency offset by 250 % of the necessary bandwidth from the wanted signal. For each test the level of the unwanted signal shall be adjusted until the SINAD ratio at the receiver output is reduced from 12 dB SINAD to 6 dB SINAD.

6.2.2.3 Frequency modulation FM

The test input signal to the receiver shall be the normal test signals specified in clause 4.10. The arrangements for applying two test signals to the receiver input, shall be according to clause 4.9.

The test shall be performed on frequencies as defined in clause 4.2.

An unwanted second signal shall be applied at a frequency offset by 250 % of the necessary bandwidth from the wanted signal. For each test the level of the unwanted signal shall be adjusted until the SINAD ratio at the receiver output is reduced from 12 dB SINAD to 6 dB SINAD.

6.2.2.4 Other types of modulation

The test input signal to the receiver shall be the normal test signals specified in clause 4.10 set to the declared sensitivity value. The arrangements for applying two test signals to the receiver input, shall be according to clause 4.9.

The test shall be performed on frequencies as defined in clause 4.2.

An unwanted second signal shall be applied at a frequency offset by 250 % of the necessary bandwidth from the wanted signal. For each test the level of the unwanted signal shall be adjusted until the receive functionality as declared by the manufacturer is lost.

6.2.3 Limits

Table 12: Adjacent channel selectivity

Equipment type	AM	SSB	FM	Other
Base station/Mobile	60 dB	60 db	60 dB	60 dB
Handheld	55 dB	55 dB	55 dB	55 dB

6.3 Conducted RF immunity

6.3.1 Definition

This 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 any frequencies other than those of the spurious responses or the adjacent channels.

NOTE: In normal use, amateur radio transmitting equipment is not collocated with other radio transmitters operating within 10 % of its own carrier frequency, so that inter-transmitter intermodulation will not occur. Therefore immunity testing of the transmitter antenna port is not justified and is not included in the present document.

6.3.2 Method of measurement

6.3.2.1 Method of measurement (analogue)

This test is applicable to base station, mobile, portable and ancillary equipment.

This test shall not apply to RF low-noise preamplifiers intended for location directly at the antenna.

The measurement procedure shall be as follows:

- Two signal generators, A and B, shall be connected to the receiver via a combining network (see clause 4.9):
  - Signal generator A shall be set to the nominal frequency of the receiver, with normal test modulation, (see table 1) and shall be applied to the receiver input connector via one input of the combining network at 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.
  - Signal generator B shall provide the unwanted signal as specified by table 8 and shall be applied to the receiver input connector via one input of the combining network.

The test shall be performed over the frequency range 150 kHz to 1 GHz using stepped increments of maximum 1 % of the momentary frequency with the exception of the exclusion band.

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

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

In the case of 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.

In the case of 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 signal test frequencies shall extend from -5 % to +5 % of each wanted signal test frequency.

The test shall be applied to the receiver input connector via the second input of the combining network.

Discrete spurious responses shall be ignored.

6.3.2.2 Method of measurement (digital)

This test is applicable to base station, mobile, portable and ancillary equipment.

This test shall not apply to RF low-noise preamplifiers intended for location directly at the antenna.

For digital equipment that supports adaptive rates, testing is only required at the maximum bit rate that the manufacturer declares is compliant to the present document.

The measurement procedure shall be as follows:

- Two signal generators, A and B, shall be connected to the receiver via a combining network (see clause 4.9):
  - Signal generator A shall be set to the nominal frequency of the receiver, with normal test modulation, (see table 1) and shall be applied to the receiver input connector via one input of the combining network at 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.
  - Signal generator B shall provide the unwanted signal as specified by table 13 and shall be applied to the receiver input connector via one input of the combining network.

The test shall be performed over the frequency range 150 kHz to 1 GHz using stepped increments of maximum 1 % of the momentary frequency with the exception of the exclusion band.

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

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

In the case of 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.

In the case of 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 signal test frequencies shall extend from -5 % to +5 % of each wanted signal test frequency.

The test shall be applied to the receiver input connector via the second input of the combining network.

Discrete spurious responses shall be ignored.

6.3.2.3 Unwanted signal parameters (analogue and digital)

The unwanted signal specified in clauses 5.3.2.1 and 5.3.2.2 shall have the parameters given in table 13.

Table 13: Unwanted signal parameters

Operating frequency range of EUT	Characteristics of the unwanted signal	Units
Below or equal to 30 MHz	90 80 0,15 to 1 000	dBµV emf % AM (400 Hz) MHz
Above 30 MHz	80 80 0,15 to 1 000	dBµV emf % AM (400 Hz) MHz

6.3.3 Limit

Application of the test signal shall not cause the demodulated receiver output to:

- be reduced to less than 12 dB SINAD for analogue speech equipment; or
- be reduced to less than 80 % of the original data throughput for non-speech equipment; or
- be degraded.

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

The present document has been prepared in reply to the Commission's standardisation request Commission Implementing Decision C(2015) 5376 final of 04.08.2015 to provide a 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.

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 301 783 The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.5]				
Requirement			**Requirement Conditionality**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**
1	Maximum Transmitter power	5.1	U	
2	Unwanted emissions in the spurious domain	5.2	U	
3	Spurious radiations	5.3	U	
4	Maximum usable sensitivity	6.1	U	
5	Adjacent channel selectivity	6.2	U	
6	Conducted RF immunity	6.3	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.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement shall be unconditionally applicable (U) or is conditional upon the manufacturers claimed functionality of the equipment (C).

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

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

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

History

Document history		
V1.1.1	September 2000	Publication as ETSI EN 301 783 part 1 and part 2
V1.2.1	July 2010	Publication as ETSI EN 301 783 part 1 and part 2
V2.1.0	August 2015	EN Approval Procedure AP 20151218: 2015-08-20 to 2015-12-18
V2.1.1	January 2016	Publication