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Technical characteristics and methods of measurement for fixed and portable VHF equipment operating on 121,5 MHz and 123,1 MHz

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Contents

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Foreword

This final draft European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI standards EN Approval Procedure.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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

1 Scope

The present document specifies the minimum technical requirements for maritime two-way AM VHF radiotelephone apparatus for communications between ships in distress and rescuing aircraft. The present document incorporates relevant provisions of the ITU Radio Regulations [i.1], of IMO Resolutions A.694(17) [i.2] and MSC.80(70) [i.3] and of annex 10 to the ICAO Convention [i.4].

The maritime VHF equipment described in the present document is intended for communications on the aeronautical emergency frequencies 121,5 MHz and 123,1 MHz only.

The present document is applicable to portable and fixed installed equipment.

NOTE: This type of equipment is covered by the Maritime Equipment Directive [i.6] and its subsequent revisions.

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 reference 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] ETSI EN 300 225: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Technical characteristics and methods of measurement for survival craft portable VHF radiotelephone apparatus".

[2] ISO 25862:2009: "Ships and marine technology -- Marine magnetic compasses, binnacles and azimuth reading devices".

[3] CENELEC EN 60945:2002: "Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results".

[4] 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 reference 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] ITU Radio Regulations 2012.

[i.2] IMO Resolution A.694(17): "General Requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids".

[i.3] IMO Resolution MSC.80(70): "Adoption of new Performance Standards for radiocommunication equipment".

[i.4] ICAO Convention on International Civil Aviation, annex 10.

[i.5] ETSI TR 100 028: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[i.6] Council Directive 96/98/EC of 20 December 1996 on marine equipment.

3 Symbols and abbreviations

3.1 Symbols

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

A3E	amplitude modulation with double sideband and full carrier
dBA	acoustic level in dB relative to 2×10^{-5} Pa
dBd	antenna gain in dB relative to dipole radiation

3.2 Abbreviations

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

AM	Amplitude Modulation
emf	electro-motive force
ERP	Effective Radiated Power
EUT	Equipment Under Test
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
MSC	Maritime Safety Committee
pep	peak envelope power
RF	Radio Frequency
rms	root mean square
SINAD	Signal + Noise + Distortion/Noise + Distortion
VHF	Very High Frequency

4 General requirements

4.1 Construction

Portable equipment shall in one unit comprise at least transmitter, receiver, antenna, battery, operating controls including press-to-transmit switch, microphone and loudspeaker.

Equipment intended for fixed installations shall have an 50 Ω RF socket.

Portable equipment shall be of small size and light in weight.

Portable equipment shall include provision for the connection of external microphone and headset.

Portable equipment shall have a colour which distinguishes it from the portable VHF equipment specified in ETSI EN 300 225 [1].

The equipment shall be operational within 5 seconds of switching on.

Fixed installation equipment shall be so installed that access for inspection or maintenance shall be available.

4.2 Controls

The number of controls shall be the minimum necessary for simple operation.

The equipment shall be provided with an on-off switch and a visual indication that the equipment is switched on.

The equipment shall be provided with a manual volume control by which the audio output may be varied.

The press-to-transmit switch shall be non-locking and return to standby (receive) mode when released. The time necessary to change from transmission to reception, or vice versa, shall not exceed 0,3 seconds.

The equipment shall have a channel selector and shall clearly indicate which frequency the equipment is set to. The channel switching arrangement shall be such that the time necessary to change from one frequency to the other does not exceed 5 seconds. It shall not be possible to transmit during channel switching operations. Independent selection of transmitting and receiving frequencies shall not be possible. In the transmission mode, the output of the receiver shall be muted.

4.3 Operating frequencies

The equipment shall be capable of operating on the single frequency channels 121,5 MHz and 123,1 MHz only (aeronautical emergency frequencies), with manual control (simplex).

The equipment shall operate with class of emission A3E.

4.4 Labelling

The labels on the equipment shall be permanently fixed to the exterior of the equipment.

All controls and indicators shall be clearly labelled.

The labelling shall at least comprise the following information:

- text containing the words: "Only for emergency communications with aircraft";
- brief operating instructions;
- type designation of the equipment and serial number;
- expiry date for any primary batteries;
- compass safe distance, according to ISO 25862 [2].

4.5 Power source

For portable equipment, the source of energy shall be a primary battery that may be replaceable by the user without the use of special tools and without degrading the performance of the equipment. In addition, provisions may be made to operate the equipment using an external source of electrical energy.

Fixed radio installation should be powered from the ship's main source of electrical energy. In addition, it should be possible to operate the installation from an alternative source of electrical energy. Alternatively, the source of energy may be a primary battery integrated in the equipment and may be replaceable by the user.

Primary batteries shall have a shelf life of at least 2 years.

Provisions shall be made for protecting the equipment from damage due to accidental reversal of the polarity of the battery or of any external power supply.

The capacity of the primary battery shall be sufficient to operate the equipment continuously for at least 8 hours at normal temperature condition (see clause 5.4.1) with the duty cycle defined in clause 5.1.

5 Test conditions, power sources and ambient temperatures

5.1 Determination of the lower extreme test voltage

When determining the capacity of the primary battery, the battery voltage shall be measured at the end of a duration test. During this duration test, when activated, the transmitter should be modulated to give maximum output power (pep at 100 % modulation). The equipment shall be operated with the following duty cycle:

- 6 seconds transmission without modulation followed by 6 seconds reception with an RF input signal at the nominal frequency of the receiver at a level of +60 dBµV using normal test modulation (clause 6.4) with the audio volume control set to give minimum 200 mW output power followed by 48 seconds reception without input signal under muted condition (operational squelch condition).

The lower extreme test voltage is the voltage of the battery at the end of this duration test measured with the transmitter activated.

5.2 Normal and extreme test conditions

Testing of the equipment shall be made under normal test conditions and also, where stated, under extreme test conditions.

5.3 Test power source

During testing, the equipment shall be supplied from a test power source capable of producing normal and extreme test voltages as specified in clauses 5.4.2 and 5.5.2. The tests power source shall only be used in measurements where its effect on the test results is negligible. The power source voltage shall be measured at the input terminals of the equipment.

During testing, the power source voltages shall be maintained within a tolerance of ±3 % relative to the voltage level at the beginning of each test.

5.4 Normal test conditions

5.4.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be a combination of temperature and humidity within the following limits:

- Temperature +15 °C to +35 °C;
- Relative humidity 20 % to 75 %.

5.4.2 Normal power source

For portable equipment, the normal test voltage shall be the nominal voltage of the battery as declared by the manufacturer.

For fixed installation equipment, the normal test voltage shall be that declared by the manufacturer. If the normal power source is ac, then the frequency of the test voltage shall be 50 Hz ± 1 Hz.

5.5 Extreme test conditions

5.5.1 Extreme temperatures

5.5.1.1 Upper extreme temperature

Tests at the upper extreme temperature shall be made at a temperature of +55 °C.

5.5.1.2 Lower extreme temperature

Tests at the lower extreme temperature shall be made at a temperature of -20 °C.

5.5.2 Extreme test power supply values

5.5.2.1 Upper extreme test voltage

For portable equipment, the upper extreme test voltage shall be determined in each case and should be the voltage corresponding to the voltage that the battery gives at the upper extreme temperature at the beginning of the battery test cycle with a load equal to that of the equipment in the standby condition.

For fixed installation equipment, the upper extreme test voltage shall be:

- ac powered equipment: the nominal mains voltage +10 %. The frequency shall be 50 Hz ± 5 Hz.
- dc powered equipment: the nominal dc voltage +30 %.

5.5.2.2 Lower extreme test voltage

The equipment fitted with an unused primary battery shall be placed in a climatic chamber and cooled to -20 °C allowing a stabilization period of 2 hours. The equipment shall be activated as described in clause 4.5. After this test the battery voltage shall be measured during equipment transmission. This voltage shall be taken as the lower extreme test voltage, and shall be measured before disconnecting the load.

For fixed installation equipment, the lower extreme test voltage shall be:

- ac powered equipment: the nominal mains voltage -10 %. The frequency shall be 50 Hz ± 5 Hz.
- dc powered equipment: the nominal dc voltage -10 %.

5.6 Procedure for tests at extreme temperatures

The equipment shall be switched off during the temperature-stabilizing periods.

Before conducting tests at the upper temperature, the equipment shall be placed in the test chamber and left until thermal equilibrium is reached. The equipment shall then be switched on for half an hour during which the transmitter shall be keyed with a duty cycle of 5 minutes transmission and 5 minutes reception.

For tests at the lower temperature, the equipment shall be left in the test chamber until thermal equilibrium is reached and shall then be switched to the standby or receive position for 1 minute.

6 General conditions of measurements

6.1 Test connections

For the purpose of testing, the equipment shall be provided with suitable connections to test points within the equipment, which allow easy access to:

- the transmitter output (for 50 Ω connection);
- the receiver input (for 50 Ω connection);
- the transmitter audio input(s);
- the receiver audio output(s);
- the push-to-talk switch;
- power supply input.

6.2 Arrangements for test signals applied to receiver input

Test signal generators shall be connected to the receiver input in such a way that the impedance presented to the receiver input is 50 Ω, irrespective of whether one or more test signals are applied to the receiver simultaneously.

The levels of the test signals shall be expressed in terms of the electromotive force (emf) at the terminals to be connected to the receiver.

The effects of any intermodulation product and noise product in the test signal generators shall be negligible.

The nominal frequency of the receiver is the carrier frequency of the selected channel.

6.3 Squelch

Unless otherwise stated, the receiver squelch facility, if any, shall be made inoperative for the duration of the conformance tests.

6.4 Normal test modulation

For signals applied to the receiver, the normal test modulation frequency shall be 1 kHz and the modulation depth shall be 30 %, unless otherwise stated.

6.5 Artificial antenna

When tests are conducted with an artificial antenna, this shall be a 50 Ω non-reactive, non-radiating load.

6.6 Test frequencies

Tests shall be made on 123,1 MHz, unless otherwise stated. When testing on 121,5 MHz, care should be taken to avoid radiation that could cause false distress alerts.

6.7 Measurement uncertainty and interpretation of the measuring results

6.7.1 Measurement uncertainty

Absolute measurement uncertainties: maximum values

RF frequency	$\pm 1 \times 10^{-7}$
RF power	±0,75 dB
Audio output power	±0,5 dB
Sensitivity at 12 dB SINAD	±3 dB
Two signal measurement	±4 dB

For the test methods according to this report the uncertainty figures are valid to a confidence level of 95 % calculated according to the methods described in ETSI TR 100 028 [i.5].

6.7.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in this report shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the proposed limits of this report;
- the measurement uncertainty value for the measurement of each parameter should be included in the test report;

- the recorded value of the measurement uncertainty should be, for each measurement, equal to or lower than the maximum values given above.

7 Environmental tests

7.1 Introduction

The tests in this clause are performed in order to simulate the environment in which the equipment is intended to operate.

7.2 Procedure

All tests with respect to the requirements of the present document shall be carried out on a single sample of the EUT.

Environmental tests shall be carried out before tests with respect to the other requirements of the present document.

The following tests shall be carried out in the order they appear.

Unless otherwise stated, the equipment shall be connected to an electrical power source only during the periods for which it is specified that electrical tests shall be carried out. These shall be done with normal test voltage.

7.3 Performance check

The term performance check shall be taken to mean an inspection to check if there is any visible damage or deterioration and the following measurements:

- for the transmitter: carrier frequency power and frequency error (clauses 8.1 and 8.2);
- for the receiver: maximum usable sensitivity (clause 9.2).

7.4 Drop test on hard surface

This test is applicable only for portable equipment.

The equipment shall be subject to the test contained in CENELEC EN 60945 [3], clause 8.6.1.

During the test the equipment shall be fitted with a suitable set of batteries and antenna but it shall be switched off.

7.5 Vibration test

The equipment shall be subject to the test contained in CENELEC EN 60945 [3], clause 8.7.

For portable equipment, the equipment with any accessory for storing, shall be clamped to the vibration table as it is intended to be stored on board a ship.

Equipment for fixed installations shall be clamped to the vibration table in its intended normal installation attitude.

7.6 Temperature tests

7.6.1 General

The maximum rate of raising or reducing the temperature of the chamber in which the equipment is being tested shall be 1 °C/min.

7.6.2 Dry heat cycle

The equipment shall be placed in a chamber at normal temperature. The temperature shall then be raised to, and maintained at, +70 °C (±3 °C) for a period of at least 10 hours. After this period any climatic control device provided in the equipment may be switched on and the chamber cooled to +55 °C (±3 °C). The cooling of the chamber shall be completed within 30 minutes.

The equipment shall then be switched on and shall be kept working continuously for a period of 2 hours. The transmitter shall be keyed with a duty cycle of 5 minutes transmission and 5 minutes reception. The equipment shall be subjected to a performance check during the 2 hours period.

The temperature of the chamber shall be maintained at +55 °C (±3 °C) during the 2 hours period.

At the end of the test, and with the equipment still in the chamber, the chamber shall be brought to room temperature in not less than 1 hour. The equipment shall then be exposed to normal room temperature and humidity for not less than 3 hours before the next test is carried out.

7.6.3 Damp heat cycle

The equipment shall be subject to the test contained in CENELEC EN 60945 [3], clause 8.3.7.6.4.

The equipment shall be subject to the test contained in CENELEC EN 60945 [3], clause 8.4 and fixed equipment shall be classed as "protected".

7.6.4 Low temperature cycle

7.6.4.1 Method of measurement

The equipment shall be placed in a chamber at normal room temperature. Then the temperature shall be reduced to and maintained at -30 °C (±3 °C) for a period of at least 10 hours.

Any climatic devices provided within the equipment may then be switched on and the chamber shall be warmed to -20 °C (±3 °C). The warming of the chamber shall be completed within 30 minutes (±5 minutes).

The temperature of the chamber shall be then maintained at -20 °C (±3 °C) during a period of 1 hour 30 minutes.

The equipment shall be subjected to a performance check during the last 30 minutes of the test.

At the end of the test and with the equipment still in the chamber, the chamber shall be brought to room temperature in not less than 1 hour. The equipment shall then be exposed to normal room temperature for not less than 3 hours, or until moisture has dispersed, whichever is longer, before the next test is carried out.

Throughout the test the equipment shall be in the receive condition.

7.7 Immersion test

This test is only applicable to portable equipment.

The equipment shall be subject to the test contained in CENELEC EN 60945 [3], clause 8.9.3.

8 Transmitter

8.1 Carrier power

8.1.1 Definition

The carrier power is the mean power delivered to the artificial antenna during one radio frequency cycle in the absence of modulation.

8.1.2 Method of measurement

The transmitter shall be connected to an artificial antenna (clause 6.5) and activated without modulation. The power delivered to the antenna shall be measured.

The measurement shall be made on both 121,5 MHz and 123,1 MHz under normal test conditions and also under extreme test conditions.

8.1.3 Limit

The carrier power shall be between 50 mW and 1,5 W.

8.2 Frequency error

8.2.1 Definition

The frequency error is the difference between the measured carrier frequency and its nominal value.

8.2.2 Method of measurement

The transmitter shall be connected to an artificial antenna (clause 6.5) and activated without modulation. The carrier frequency shall be measured under normal test conditions and also under extreme test conditions.

8.2.3 Limit

The frequency error shall be less than ±15 ppm.

8.3 Modulation of the transmitter

8.3.1 Definition

The modulation of the transmitter is the depth of modulation that is produced at the transmitter output when a certain sound level is applied to the microphone.

8.3.2 Method of measurement

An acoustic signal with a frequency of 1 kHz and a level of 94 dBA ± 3 dB at the microphone shall be applied. The depth of modulation at the transmitter output and the distortion in the recovered transmit audio shall be measured.

8.3.3 Limit

The depth of modulation shall be at least 70 %.

The distortion shall be less than 10 %.

8.4 Conducted spurious emissions conveyed to the antenna

8.4.1 Definition

Conducted 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.

8.4.2 Method of measurement

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna (clause 6.5).

The measurements shall be made over the range from 9 kHz to 2 GHz, excluding the channel on which the transmitter is operating and its adjacent channels.

The measurements shall be made using a selective measuring device such as a tuned radio measuring instrument or a spectrum analyser.

8.4.3 Limit

The power of any conducted spurious emission on any discrete frequency shall not exceed 0,25 µW from 9 kHz to 1 GHz and 1µW from 1 to 2 GHz.

8.5 Cabinet radiation

8.5.1 Definitions

Cabinet radiation consists of emissions radiated by the equipment cabinet and structures. These spurious emissions are measured in terms of effective radiated power (ERP).

8.5.2 Method of measurement

On a test site, which shall be selected from ETSI TS 103 052 [4], the equipment shall be placed at the specified height on a non-conducting support and in position closest to normal use as declared by the manufacturer.

The EUT antenna connector shall be connected to a non-radiating load.

The test antenna shall be orientated for vertical polarization.

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

The transmitter shall be switched on without modulation, and the measuring receiver shall be tuned over the frequency range 30 MHz to 2 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

At each frequency at which a spurious component is detected:

a) 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;

b) the EUT shall be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver;

c) the maximum signal level detected by the measuring receiver shall be noted;

d) the transmitter shall be replaced by a calibrated substitution antenna as defined in ETSI TS 103 052 [4];

e) 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;

g) the frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected;

h) if necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver;

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

j) the input signal to the substitution antenna shall be adjusted to produce a level detected by the measuring receiver, equal to the level noted while the spurious component was measured (taking into account any change of input attenuator setting of the measuring receiver);

k) the input power level to the substitution antenna shall be recorded;

l) the measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization;

m) at each spurious emission frequency the ERP is the larger of the two power levels recorded, for horizontal and vertical polarization at the input to the substitution antenna. The measurement shall be corrected for the gain of the substitution antenna, in dBd, and for any change to the input attenuation of the measuring receiver between the EUT and substitution phases of the measurement;

n) the measurements shall be repeated with the EUT on stand-by.

8.5.3 Limits

When the transmitter is in stand-by the cabinet radiation shall not exceed 2 nW from 30 MHz to 1 GHz and 20 nW from 1 to 2 GHz.

When the transmitter is in operation the cabinet radiation shall not exceed 0,25 µW from 30 MHz to 1 GHz and 1 µW from 1 to 2 GHz.

9 Receiver

9.1 Harmonic distortion and audio frequency output power

9.1.1 Definition

The harmonic distortion at the receiver output is defined as the ratio, expressed as a percentage, of the total rms voltage of all the harmonic components of the modulation audio frequency to the total rms voltage of the signal delivered by the receiver.

The audio-frequency output power is the maximum power available at the output, for which the harmonic distortion is below a certain level.

9.1.2 Method of measurement

A test signal with normal test modulation as defined in clause 6.4 and with a level of +120 dBµV at one of the two nominal frequencies of the receiver shall be applied to the receiver input.

The output of the receiver shall be connected to a resistive load simulating the receiver's operating load.

The harmonic distortion and output power shall be measured.

The audio frequency volume control of the receiver shall be set so that the harmonic distortion is 10 % or so that the volume control is in the maximum position whichever comes first.

9.1.3 Limit

The audio frequency output power shall be at least 200 mW.

9.2 Maximum usable sensitivity

9.2.1 Definition

The maximum usable sensitivity of the receiver is the minimum level of the RF signal at the nominal frequency of the receiver which, when applied to the receiver input with normal test modulation, will produce an audio frequency output power equal to at least 50 % of the maximum audio frequency output power (see clause 9.1) and a SINAD ratio of 12 dB.

9.2.2 Method of measurement

A test signal modulated with normal test modulation (clause 6.4) at one of the two nominal frequencies of the receiver shall be applied to the receiver input.

The output of the receiver shall be connected to a resistive load simulating the receiver's operating load.

The SINAD ratio shall be measured.

The level of the test signal should be adjusted until a SINAD ratio of 12 dB is obtained, using the receiver's audio frequency power control adjusted to produce 50 % of the maximum audio frequency output power measured in clause 9.1.

The measurement should be made on both 121,5 MHz and 123,1 MHz under normal test conditions and also under extreme test conditions.

9.2.3 Limit

The maximum usable sensitivity shall be better than -101 dBm under normal conditions and -95 dBm under extreme conditions.

9.3 Spurious response rejection

9.3.1 Definition

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

Spurious responses may occur at all frequencies throughout the frequency spectrum and the requirements of the present document shall be met for all frequencies. However, for practical reasons the measurements for type testing shall be performed as specified in the present document. More specifically, this method of measurement is not intended to capture all spurious responses but selects those that have a high probability of being present. However, in a limited frequency range close to the nominal frequency of the receiver, it has been considered impossible to determine the probability of spurious responses and therefore a search shall be performed over this limited frequency range. This method provides a high degree of confidence that the equipment also meets the requirements at frequencies not being measured.

9.3.2 Introduction to the method of measurement

To determine the frequencies at which spurious responses can occur the following calculations shall be made:

a) Calculation of the limited frequency range

The limited frequency range is defined as the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the sum of the intermediate frequencies ($f_{i1}...f_{in}$) and a half of the maximum frequency range (fr_m) of the receiver.

Hence the frequency f_L of the limited frequency range is:

$$f_{LO} - \sum_{j=1..n} f_{ij} - fr_m/2 \leq f_L \leq f_{LO} + \sum_{j=1..n} f_{ij} + fr_m/2$$

b) Calculation of frequencies outside the limited frequency range

The frequencies outside the limited frequency range determined in a) are equal to the harmonics of the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the first intermediate frequency (f_{i1}) of the receiver.

Hence the frequencies of these spurious responses are $nf_{LO} \pm f_{i1}$, where n is an integer greater than or equal to 2.

The measurement of the first image response of the receiver shall initially be made to verify the calculation of spurious response frequencies.

For calculations a) and b), the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver, the intermediate frequencies (f_{i1}, f_{i2}, etc.), and the maximum frequency range (fr_m) of the receiver.

9.3.3 Method of search of the limited frequency range

The test signal shall be at the nominal frequency and amplitude modulated by 1 kHz at a modulation depth of 30 %.

The test signal shall be adjusted to a level corresponding to a SINAD ratio of 12 dB and recorded as the reference level.

The input level of the test signal shall then be adjusted to 80 dB above the reference level.

The frequency shall be varied continuously over the limited frequency range determined in clause 9.3.2 a) and over the frequencies outside the frequency range in accordance with the calculations in clause 9.3.2 b).

The frequency of any spurious responses detected during the search shall be recorded for the use in the measurement described in the following clause.

9.3.4 Method of measurement

The test signal from a signal generator shall be applied to the receiver input. A rms voltmeter shall be connected to the receiver output.

The test signal shall have normal test modulation (clause 6.4) at the nominal frequency of the receiver.

The RF signal level shall be adjusted to produce a SINAD ratio according of 12 dB, recorded as the reference level.

The signal generator shall then be tuned to a spurious response frequency detected according to clause 9.3.3 and modulated with normal test modulation.

The level of the RF signal is increased until the receiver output signal produces an SINAD ratio of 12 dB.

This RF signal level shall be recorded as the unwanted signal level.

The spurious response rejection ratio is the ratio in dB of the unwanted signal level to the reference level.

This measurement shall be made for each frequency detected according to clause 9.3.3.

9.3.5 Limit

At any frequency separated from the nominal frequency of the receiver by more than two channels, the spurious response rejection ratio shall be not less than 70 dB.

9.4 Conducted spurious emissions

9.4.1 Definition

Conducted spurious emissions from the receiver are defined as components at any frequency, conducted to the antenna of the equipment.

9.4.2 Method of measurement

Conducted spurious emissions shall be measured with the receiver switched on and connected to the artificial antenna (clause 6.5).

The measurements shall be made over the range from 9 kHz to 2 GHz.

The measurements for each spurious emission shall be made using a selective measuring device such as a tuned radio measuring instrument or a spectrum analyser.

9.4.3 Limit

The power of any conducted spurious emission shall not exceed 2 nW from 9 kHz to 1 GHz and 20 nW from 1 to 2 GHz.

History

Document history				
V1.1.1	July 2000	Publication		
V1.2.1	April 2015	EN Approval Procedure	AP 20150822:	2015-04-24 to 2015-08-24
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