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**Technical characteristics and methods of measurement  
for two-way VHF radiotelephone apparatus  
for fixed installation in survival craft**

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Reference

REN/ERM-TG26-516

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Keywords

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## Foreword

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

<b>National transposition dates</b>	
Date of adoption of this EN:	7 December 2015
Date of latest announcement of this EN (doa):	31 March 2016
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## 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 states the minimum technical characteristics required for VHF radiotelephone equipment, operating in the bands between 156 MHz and 174 MHz allocated to the Maritime Mobile Services and suitable for fixed installations in survival craft in accordance with the provisions of the Global Maritime Distress and Safety System (GMDSS). The relevant requirements detailed in the Radio Regulations [5], International Convention for the Safety Of Life At Sea SOLAS 1974 [4] and the International Maritime Organization Resolutions A.694 [i.3] and A.809 [i.2] as well as all relevant requirements of CENELEC EN 60945 [i.5] are incorporated in the present document.

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## 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.

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

- [1] Recommendation ITU-T O.41 (1994): "Psophometer for use on telephone-type circuits".
- [2] IEC 60068-2-27: 2008 Edition 4.0: "Environmental testing. Part 2-27: Tests - Test Ea and guidance: Shock".
- [3] ISO 25862 (2009): "Ships and marine technology -- Marine magnetic compasses, binnacles and azimuth reading devices".
- [4] SOLAS 1974: "International Maritime Organization (IMO), International Convention for the Safety Of Life At Sea (SOLAS), (1974 as amended)".
- [5] ITU Radio Regulations (2012), Appendix 18: "Table of transmitting frequencies in the VHF maritime mobile band".
- [6] ETSI TS 103 052: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

### 2.2 Informative references

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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] Void.
- [i.2] International Maritime Organization Resolution A.809 (19): "Performance standards for survival craft two way VHF radiotelephone apparatus".
- [i.3] International Maritime Organization 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.4] Void.
- [i.5] CENELEC EN 60945 (2002) + Corrigendum 1 (2008): "Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results".
- [i.6] ETSI TR 100 028 (All parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

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

**modulation index:** ratio of the frequency deviation to the modulation frequency

**primary battery:** non rechargeable battery which may be user replaceable

NOTE: See International Maritime Organization Resolution A.809(19) [i.2].

**rated output power:** output power as defined by the manufacturer

**secondary battery:** rechargeable battery

NOTE: See International Maritime Organization Resolution A.809(19) [i.2].

### 3.2 Symbols

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

dBA	Acoustic level in dB relative to $2 \times 10^{-5}$ Pascal
g	Acceleration of gravity ( $\approx 9,81$ m/s <sup>2</sup> )
G3E	Phase modulation for voice
Q	Ratio of an observed acceleration at the equipment to the acceleration at the base of the vibration table

### 3.3 Abbreviations

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

ad	amplitude difference
DSC	Digital Selective Calling
emf	electro-motive force
ERP	Effective Radiated Power
EUT	Equipment Under Test
fd	frequency difference
GMDSS	Global Maritime Distress and Safety System
IF	Intermediate Frequency
RF	Radio Frequency
rms	root mean square
SINAD	(Signal + Noise + Distortion)/(Noise + Distortion) ratio
SOLAS	International Convention for the Safety of Life at Sea
VHF	Very High Frequency

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## 4 General requirements

### 4.1 Construction

The equipment shall be capable of being used for on-scene communications between survival craft, between survival craft and ship and between survival craft and rescue unit.

The equipment shall comprise at least:

- a transmitter and receiver;
- an antenna which may be fixed to the equipment or mounted separately; and
- a microphone with press-to-talk switch and a loudspeaker.

The equipment shall be fitted with an external 50  $\Omega$  antenna connector.

The equipment may be operated from an external or integrated power source. An integrated power source may consist of primary or secondary batteries.

The mechanical and electrical construction and finish of the equipment shall conform in all respects to good engineering practice and the equipment shall be suitable for use in survival craft at sea.

All controls shall be of sufficient size to enable the usual control functions to be easily performed by a user wearing gloves for immersion suits, in accordance with SOLAS 1974 [4] Chapter III, Regulation 33. The number of controls should be the minimum necessary for simple and satisfactory operation.

Any parts of the equipment required to be checked during inspection or maintenance operations as laid down by the manufacturer, shall be readily accessible. Components shall be readily identifiable.

For the purpose of conformance testing in accordance with the present document, adequate technical and operational documentation shall be supplied with the equipment.

### 4.2 Frequencies and power

The equipment shall operate only on single-frequency channels for voice communications with manual control (simplex).

The equipment shall provide for transmission and reception of signals on channel 16 and at least one other single frequency channel from those specified in Appendix 18 of the Radio Regulations [5], (with the exception of the DSC calling channel 70 and AIS1 and AIS2).

NOTE: Preference shall be given to simplex channels where analogue voice is the priority mode.

Independent selection of transmitting and receiving frequencies shall not be possible.

After switch on the equipment shall be operational within 5 seconds.

It shall not be possible to transmit during channel switching operations.

### 4.3 Controls

The equipment shall have a channel selector and shall indicate the designator of the channel at which the equipment is set, as given in Appendix 18 of the Radio Regulations [5].

It shall be possible to determine that channel 16 has been selected in all ambient light conditions.

The equipment shall have the following additional controls:

- on/off switch for the equipment with a visual indication that the equipment is switched on;
- a manual non-locking push to talk switch to operate the transmitter;

- if the transmitter ERP is greater than 1 watt, a switch for reducing the power to a level not exceeding 1 watt ERP;
- an audio-frequency volume control;
- a squelch control;
- a carrier power detector giving a visual indication that the carrier is being produced.

The user shall not have access to any control which may impair the technical characteristics of the equipment if wrongly set.

## 4.4 Switching time

The channel switching arrangements shall be such that the time necessary to change over from using one of the channels to using any other channel does not exceed 5 seconds.

The time necessary to change over from transmission to reception and vice versa, shall not exceed 0,3 seconds.

## 4.5 Safety precautions

Means shall be incorporated to prevent damage to the equipment due to reversal of polarity of the battery power supply.

The equipment shall be designed to be free of sharp projections which could damage survival craft.

The equipment shall not be damaged by the effects of an open circuit or a short circuit of the antenna.

## 4.6 Class of emission and modulation characteristics

The equipment shall use phase modulation, G3E (frequency modulation with a pre-emphasis of 6 dB/octave) for speech.

The equipment shall be designed to operate satisfactorily to the requirements of the present document with a channel separation of 25 kHz.

## 4.7 Power supply

### 4.7.1 Power supply capacity

The capacity of the power supply shall be sufficient to operate the equipment continuously for at least eight hours at any temperature condition (see clauses 5.3.1 and 5.4.1) with a 1 : 9 transmit to receive duty cycle at the highest rated transmit power.

This duty cycle is defined as:

- 6 s transmit at full RF output power without modulation, 6 s reception with an RF input signal at the nominal frequency of the receiver at a level of +60 dB $\mu$ V using normal test modulation (clause 6.4); and
- the audio volume control of the receiver set at maximum followed by 48 s reception without input signal and the squelch control operational (muted).

### 4.7.2 Primary batteries

Primary batteries used as internal or external power supply shall have a shelf life of at least two years.

Provisions shall be made for replacing any battery easily without the use of special tools and without degrading the performance of the equipment (particularly water tightness after re-assembly).

### 4.7.3 Secondary batteries

Secondary batteries used as internal or external power supply shall be provided with a suitable charger as defined in clause 10.

Provisions shall be made for replacing any battery easily without the use of special tools and without degrading the performance of the equipment (particularly water tightness after re-assembly).

### 4.7.4 Connection to a survival craft battery

Where equipment is intended for connection to the on board battery of a survival craft the manufacturer shall declare the power requirements of the transceiver in Ah and the nominal voltage. This shall be detailed in the installation instructions.

The supplied data shall be verified by a check of current drawn in transmit and receive modes and the resultant equivalent for the duty cycle as defined in clause 4.7.1 shall be calculated and shall not exceed the figure declared.

## 4.8 Labelling

All controls and indicators shall be clearly labelled.

The equipment shall be clearly labelled with brief instructions for operation.

The equipment shall be clearly marked on the exterior with identification of the manufacturer, type designation and serial number.

The compass safe distance measured in accordance with ISO 25862 [3], shall be stated on the equipment or in the user document supplied with the equipment.

The type and designation of any integrated battery used, and the expiry date of any primary battery shall be clearly labelled.

Details of the power supply from which the equipment is intended to operate shall be clearly indicated on the equipment.

## 4.9 Audio processing

The equipment may be designed with an audio processing system for best perceived sound quality in the built-in speaker system.

It shall be possible to disable audio processing and it shall be clearly indicated whether audio processing is turned on or off. The best audio quality settings shall be provided automatically after power-on.

If audio processing is applied to the microphone input, the testing shall be performed with the processing enabled.

Audio processing may be applied to audio outputs for handset, external speaker, etc., but shall not affect line level audio interfaces.

The overall acoustic design shall be optimized for perceived speech recognition for communication and shall be designed in accordance with clause 4.1.

Where audio processing is activated it shall be assessed the acoustic speech recognition is equal to, or better than without audio processing enabled under receive conditions at sensitivity level.

Under receive conditions below sensitivity level, the acoustic speech recognition shall never be significantly decreased by enabling of audio processing.

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## 5 Test conditions, power sources and ambient temperatures

### 5.1 Normal and extreme test conditions

Conformance testing shall be made under normal test conditions and also, where stated, under extreme test conditions.

### 5.2 Test power source

During conformance testing, the equipment shall be supplied from a test power source capable of producing normal and extreme test voltages as specified in clauses 5.3.2 and 5.4.2. The test power source shall only be used in measurements where its effect on the test results shall be negligible. For the purpose of testing 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  $\pm 3$  % relative to the voltage level at the beginning of each test.

For equipment with integrated batteries, the test power source shall only be used in measurements where the use of the test power source is mutually agreed between manufacturer and test house. In the event of any discrepancy, results obtained using the batteries shall take precedence over results obtained using the test power source.

### 5.3 Normal test conditions

#### 5.3.1 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 %.

#### 5.3.2 Normal power sources

##### 5.3.2.1 External battery power source

When the equipment is designed to operate from an external battery, the normal test voltage shall be the nominal voltage of the battery (12 V, 24 V, etc.).

##### 5.3.2.2 Integrated battery power source

The normal test voltage shall be the nominal voltage of the battery as declared by the manufacturer.

### 5.4 Extreme test conditions

#### 5.4.1 Extreme temperatures

##### 5.4.1.1 Upper extreme temperature

For tests at the upper extreme temperature, measurements shall be made at a temperature of +55 °C.

##### 5.4.1.2 Lower extreme temperature

For tests at the lower extreme temperature, measurements shall be made at a temperature of -20 °C.

## 5.4.2 Extreme test power supply values

### 5.4.2.1 Upper extreme test voltage

#### 5.4.2.1.1 External battery power source

The upper extreme test voltage shall be 1,3 times the nominal voltage of the battery (12 V, 24 V, etc.).

#### 5.4.2.1.2 Internal battery power source

The upper extreme test voltage shall be determined in each case and shall be the voltage corresponding to the voltage that the battery gives at the upper extreme temperature at the beginning of the battery test cycle (see clause 4.7) with a load equal to that of the equipment in the muted receive condition for receiver measurements and the transmit condition for transmitter measurements.

### 5.4.2.2 Lower extreme test voltage

#### 5.4.2.2.1 External battery power source

The lower extreme test voltage shall be 0,9 times the nominal voltage of the battery (12 V, 24 V, etc.).

#### 5.4.2.2.2 Internal battery power source

The equipment shall be fitted with an unused primary battery and shall be placed in a climatic chamber and cooled to -20 °C allowing a stabilization period of two hours. The equipment shall be activated as described in clause 4.7 for a period of eight hours. After this period the battery voltage shall be measured during equipment transmission.

If the equipment is capable of operating with secondary batteries, it shall be fitted with a fully charged secondary battery and placed in a climatic chamber and cooled to -20 °C allowing a stabilization period of two hours. After this period the battery voltage shall be measured during equipment transmission.

The lower voltage measured shall be taken as the extreme lower test voltage.

## 5.5 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 in the high power transmit condition, and 5 minutes reception. The equipment shall meet the requirements of the present document after this period.

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 one minute, after which the equipment shall meet the requirements of the present document.

## 6 General conditions of measurement

### 6.1 Test connections

For the purposes of conformance testing, the manufacturer and the test house shall agree on suitable connections to test points within the equipment, which allow easy access to:

- the transmitter audio input(s);
- the receiver audio output(s); (where audio processing is available, it shall be disabled for all receiver tests (clause 9). The manufacturer shall provide information on how audio processing is disabled);
- the push-to-talk switch.

## 6.2 Arrangements for test signals applied to the 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  $\Omega$ , 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 emf at the terminals to be connected to the receiver.

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

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

## 6.3 Receiver mute or squelch facility

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

## 6.4 Normal test modulation

For normal test modulation, the modulation frequency shall be 1 kHz and the frequency deviation shall be  $\pm 3$  kHz.

## 6.5 Artificial antenna

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

## 6.6 Test channels

Conformance testing shall be made on channel 16 unless otherwise stated.

## 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:  $\pm 0,75$  dB.

Maximum frequency deviation:

- within 300 Hz to 6 kHz of audio frequency:  $\pm 5$  %;
- within 6 kHz to 25 kHz of audio frequency:  $\pm 3$  dB.

Deviation limitation:	$\pm 5$ %
Adjacent channel power:	$\pm 5$ dB
Audio output power:	$\pm 0,5$ dB
Amplitude characteristics of receiver limiter:	$\pm 1,5$ dB
Sensitivity at 20 dB SINAD:	$\pm 3$ dB
Two signal measurement:	$\pm 4$ dB
Three signal measurement:	$\pm 3$ dB
Radiated emission of transmitter:	$\pm 6$ dB
Radiated emission of receiver:	$\pm 6$ dB

Transmitter transient time:  $\pm 20\%$

Transmitter transient frequency:  $\pm 250\text{ Hz}$

For the test methods according to the present document the uncertainty figures are valid to a confidence level of 95 % calculated according to the methods described in ETSI TR 100 028 [i.6].

## 6.7.2 Interpretation of the measurement results

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

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the measurement uncertainty value 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 maximum values given above.

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# 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

Environmental tests shall be carried out before tests of the same equipment in respect to the other requirements of the present document are performed. The following tests shall be carried out in the order they appear in this clause.

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 performance check shall be a check of transmitter frequency error (see clause 8.1.1), transmitter carrier power (see clause 8.2.1) and maximum usable sensitivity of the receiver (see clause 9.3.1):

- The transmitter carrier frequency shall be measured on channel 16 in the absence of modulation with the transmitter connected to an artificial antenna (see clause 6.5). The test shall be carried out with output switch set in the maximum position. The frequency error shall be within  $\pm 1,5\text{ kHz}$ .
- The transmitter carrier power shall be measured on channel 16 with the transmitter connected to the artificial antenna (see clause 6.5). The test shall be carried out with the output switch set in the maximum position. The carrier power shall be between 0,25 W and 25 W.
- The maximum usable sensitivity of the receiver shall be measured on channel 16. A test signal modulated by the normal test modulation (see clause 6.4) shall be applied to the receiver input. An audio frequency load and an instrument for measuring SINAD ratio (through a psophometric filter as specified in clause 9.3.2) shall be connected to the receiver output terminals. The level of the test signal shall be adjusted until a SINAD ratio of 20 dB is obtained and with the receiver's audio frequency power control adjusted to produce at least 50 % of the rated output power. The level of the test signal shall not exceed +12 dB $\mu$ V (emf).

## 7.4 Vibration test

### 7.4.1 Definition

This test determines the ability of equipment to withstand vibration without resulting in mechanical weakness or degradation in performance.

## 7.4.2 Method of measurement

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the vibration table by its normal means of support and in its normal attitude. The EUT may be resiliently suspended to compensate for weight not capable of being withstood by the vibration table. Provision may be made to reduce or nullify any adverse effect on EUT performance which could be caused by the presence of an electro-magnetic field due to the vibration unit.

The EUT shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 5 Hz and up to 13,2 Hz with an excursion of  $\pm 1 \text{ mm} \pm 10 \%$  ( $7 \text{ m/s}^2$  maximum acceleration at 13,2 Hz);
- above 13,2 Hz and up to 100 Hz with a constant maximum acceleration of  $7 \text{ m/s}^2$ .

The frequency sweep rate shall be slow enough to allow the detection of resonances in any part of the EUT.

A resonance search shall be carried out throughout the test. If any resonance of the EUT has  $Q \geq 5$  measured relative to the base of the vibration table, the EUT shall be subjected to a further vibration endurance test at each resonant frequency at the vibration level specified in the test with a duration of two hours. If any resonance with  $Q < 5$  occurs the further endurance test shall be carried out at one single observed frequency. If no resonance occurred, the further endurance test shall be carried out at a frequency of 30 Hz.

Performance check(s) shall be carried out at the end of each two hour endurance test period.

The procedure shall be repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

After conducting the vibration tests, the equipment shall be inspected for any mechanical deterioration.

## 7.4.3 Requirement

The equipment shall meet the requirements of the performance check.

There shall be no harmful deterioration of the equipment visible.

## 7.5 Shock tests

### 7.5.1 Definition

This test determines the ability of equipment to withstand mechanical shock.

### 7.5.2 Method of measurement

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the table of the shock testing machine by its normal means of support and in its normal attitude.

The shock applied to the equipment shall consist of a pulse being one half-cycle of a sine wave in accordance with IEC 60068-2-27 [2].

The peak acceleration shall be 30 g and the duration shall be 18 ms.

Three successive shocks shall be applied in each direction of the three mutually perpendicular axes of the EUT.

After the test, the equipment shall be inspected for any mechanical deterioration and a performance check shall be carried out.

### 7.5.3 Requirement

The equipment shall meet the requirements of the performance check.

There shall be no harmful deterioration of the equipment visible.

## 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/minute.

### 7.6.2 Dry heat cycle

#### 7.6.2.1 Method of measurement

The equipment shall be placed in a chamber at normal temperature. The temperature shall then be raised to, and maintained at, +70 °C ( $\pm 3$  °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 ( $\pm 3$  °C). The cooling of the chamber shall be completed within 30 minutes.

The equipment shall then be switched on and set to maximum transmit power. The transmitter shall be keyed with a duty cycle of 5 minutes transmission and 5 minutes reception for a period of 2 hours. The equipment shall be subjected to a performance check at the end of the 2 hours period.

The temperature of the chamber shall be maintained at +55 °C ( $\pm 3$  °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.

#### 7.6.2.2 Requirement

The requirement of the performance check shall be met.

### 7.6.3 Damp heat cycle

#### 7.6.3.1 Method of measurement

The equipment shall be placed in a chamber at normal room temperature and humidity which, steadily, over a period of 3 hours ( $\pm 0,5$  hours), shall be heated from room temperature to +40 °C ( $\pm 3$  °C) and shall during this period be brought to a relative humidity of 93 % ( $\pm 2$  %) so that excessive condensation is avoided.

These conditions shall be maintained for a period of at least 10 hours.

After this period, any climatic control devices provided within the equipment may be switched on.

30 minutes later the equipment shall be switched on, and set to maximum transmit power. The transmitter shall be keyed with a duty cycle of 5 minutes transmission and 5 minutes reception for a period of 2 hours. The equipment shall be subjected to a performance check at the end of the 2 hours period.

The temperature and relative humidity of the chamber shall be maintained at +40 °C ( $\pm 3$  °C) and 93 % ( $\pm 2$  %) during the 2 hours 30 minutes 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, or until moisture has dispersed, whichever is longer, before the next test is carried out.

#### 7.6.3.2 Requirement

The requirement of the performance check shall be met.

## 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  $-30\text{ °C}$  ( $\pm 3\text{ °C}$ ) 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  $-20\text{ °C}$  ( $\pm 3\text{ °C}$ ). The warming of the chamber shall be completed within 30 minutes ( $\pm 5$  minutes).

The equipment shall then be switched on in the receiver mode and the temperature of the chamber shall be maintained at  $-20\text{ °C}$  ( $\pm 3\text{ °C}$ ) during a period of 90 minutes.

The equipment shall be subjected to a performance check at the end of 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.

### 7.6.4.2 Requirement

The requirements of the performance check shall be met.

## 7.7 Corrosion test

### 7.7.1 General

This test may be omitted if sufficient evidence is provided by the manufacturer that the corresponding requirements of this clause are met.

### 7.7.2 Method of measurement

The equipment shall be placed in a chamber fitted with apparatus capable of spraying in the form of fine mist, such as would be produced by a spray gun, a salt solution to the following formula:

- sodium chloride            26,50 grammes  $\pm 10\%$ ;
- magnesium chloride    2,50 grammes  $\pm 10\%$ ;
- magnesium sulphate    3,30 grammes  $\pm 10\%$ ;
- calcium chloride        1,10 grammes  $\pm 10\%$ ;
- potassium chloride      0,73 grammes  $\pm 10\%$ ;
- sodium bicarbonate     0,20 grammes  $\pm 10\%$ ;
- sodium bromide          0,28 grammes  $\pm 10\%$ ;

plus distilled water to make the solution up to 1 litre.

Alternatively a 5 % sodium chloride (NaCl) solution may be used.

The salt used for the test shall be high quality sodium chloride (NaCl) containing, when dry, not more than 0,1 % sodium iodine and not more than 0,3 % of total impurities.

Salt solution concentration shall be 5 % ( $\pm 1\%$ ) by weight.

The solution shall be prepared by dissolving 5 parts  $\pm 1$  by weight of salt in 95 parts weight of distilled or de-mineralized water.

The pH value of the solution shall be between 6,5 and 7,2 at temperature of  $20\text{ °C}$  ( $\pm 2\text{ °C}$ ). The pH value shall be maintained within this range during conditioning; for this purpose, diluted hydrochloric acid or sodium hydroxide may be used to adjust the pH value, provided that the concentration of NaCl remains within the prescribed limits. The pH value shall be measured when preparing each new batch of solution.

The spraying apparatus shall be such that the products of corrosion cannot mix with the salt solution contained within the spray reservoir.

The equipment shall be sprayed simultaneously on all its external surfaces with the salt solution for a period of 1 hour.

This spraying shall be carried out 4 times with a storage period of 7 days at 40 °C ( $\pm 2$  °C) after each spraying. The relative humidity during storage shall be maintained between 90 % and 95 %. At the end of the total period the equipment shall be examined visually.

The equipment shall then be subjected to a performance check.

### 7.7.3 Requirements

There shall be no undue deterioration or corrosion of the metal parts, finishes, material or component parts visible to the naked eye.

In the case of hermetically sealed equipment there shall be no evidence of moisture penetration.

The requirements of the performance check shall be met.

## 7.8 Immersion test

### 7.8.1 Method of measurement

A hydraulic pressure of 10 kPa, corresponding to a depth of 1 metre shall be applied for a period of 5 minutes.

Within 2 minutes after the end of the test period the equipment shall be subjected to a performance check, and be inspected for damage and visible ingress of water.

Following inspection, the equipment shall be resealed in accordance with the manufacturer's instructions.

### 7.8.2 Requirements

The requirement of the performance check shall be met.

No damage or ingress of water shall be visible to the naked eye.

## 7.9 Thermal shock

### 7.9.1 Method of measurement

The equipment shall be placed in an atmosphere of +65 °C ( $\pm 3$  °C) for 1 hour. It shall then be immersed in water at +20 °C ( $\pm 3$  °C) to a depth of 10 cm, measured from the highest point of the equipment to the surface of the water, for a period of 1 hour.

Within 2 minutes of the end of the test period the equipment shall be subjected to a performance check, and be inspected for damage and visible ingress of water.

Following inspection, the equipment shall be resealed in accordance with the manufacturer's instructions.

### 7.9.2 Requirements

The requirement of the performance check shall be met.

No damage or ingress of water shall be visible to the naked eye.

## 7.10 Oil resistance test

### 7.10.0 Applicability

This test may be omitted if sufficient evidence is provided by the manufacturer that the corresponding requirements of this clause are met.

## 7.10.1 Method of measurement

The equipment shall be immersed at a temperature of +19 °C ( $\pm 1$  °C) for 3 hours in a mineral oil of the following specification:

- aniline point: 120 °C  $\pm$  5 °C;
- flash point: minimum 240 °C;
- viscosity: 10 -25 cSt at 99 °C.

The following oils may be used:

- ASTM Oil No.1;
- ASTM Oil No.5;
- ISO Oil No.1.

After the test, the equipment shall be cleaned in accordance with the manufacturer's instructions.

## 7.10.2 Requirement

The requirement of the performance check shall be fulfilled.

There shall be no harmful deterioration of the equipment visible to the naked eye.

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# 8 Transmitter

## 8.0 General

Tests on the transmitter shall be carried out with the output power switch set at its maximum except where otherwise stated.

## 8.1 Frequency error

### 8.1.1 Definition

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

### 8.1.2 Method of measurement

The carrier frequency shall be measured in the absence of modulation, with the transmitter connected to an artificial antenna (see clause 6.5). Measurements shall be made under normal test conditions (see clause 5.3) and under extreme test conditions (clauses 5.4.1 and 5.4.2 applied simultaneously).

### 8.1.3 Limit

The frequency error shall be within  $\pm 1,5$  kHz.

## 8.2 Carrier power

### 8.2.1 Definitions

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

The rated output power is the carrier power declared by the manufacturer.

## 8.2.2 Method of measurement

The transmitter shall be connected to an artificial antenna (see clause 6.5) and the power delivered to this artificial antenna shall be measured. The measurements shall be made under normal test conditions (see clause 5.3) and also under extreme test conditions (clauses 5.4.1 and 5.4.2 applied simultaneously).

## 8.2.3 Limits

The carrier power shall be between 0,25 W and 25 W with the power switch at maximum.

The carrier power shall be between 0,25 W and 1 W with the power switch at minimum.

The measured carrier power shall not vary by more than  $\pm 1,5$  dB from the rated output power under normal test conditions and by not more than +2 dB and -3 dB under extreme test conditions.

## 8.3 Frequency deviation

### 8.3.1 Definition

The frequency deviation is the difference between the instantaneous frequency of the modulated radio-frequency signal and the carrier frequency.

### 8.3.2 Maximum frequency deviation

#### 8.3.2.1 Method of measurement

The frequency deviation shall be measured at the transmitter output, with the transmitter connected to an artificial antenna (see clause 6.5), by means of a deviation meter capable of measuring the maximum deviation, including that due to any harmonics and intermodulation products which may be generated in the transmitter.

The modulation frequency shall be varied between 100 Hz and 3 kHz. The level of this test signal shall be 20 dB above the level which produces normal test modulation (see clause 6.4). This test shall be repeated with the output power switch set at maximum and minimum.

#### 8.3.2.2 Limit

The maximum frequency deviation shall be  $\pm 5$  kHz.

### 8.3.3 Reduction of frequency deviation at modulation frequencies above 3 kHz

#### 8.3.3.1 Method of measurement

The transmitter shall operate under normal test conditions (see clause 5.3) connected to a load as specified in clause 6.5. The transmitter shall be modulated by the normal test modulation (see clause 6.4). With the input level of the modulation signal being kept constant, the modulation frequency shall be varied between 3 kHz and 25 kHz and the frequency deviation shall be measured.

#### 8.3.3.2 Limits

For modulation frequencies between 3 kHz and 6 kHz the frequency deviation shall not exceed the frequency deviation with a modulation frequency of 3 kHz. For a modulation frequency of 6 kHz, the frequency deviation shall not exceed  $\pm 1,5$  kHz.

For modulation frequencies between 6 kHz and 25 kHz, the frequency deviation shall not exceed that given by a linear response of frequency deviation (in dB) against modulation frequency, starting at the point where the modulation frequency is 6 kHz and the frequency deviation is  $\pm 1,5$  kHz and inclined at 14 dB per octave, with the frequency deviation diminishing as the modulation frequency increases as shown in figure 1.

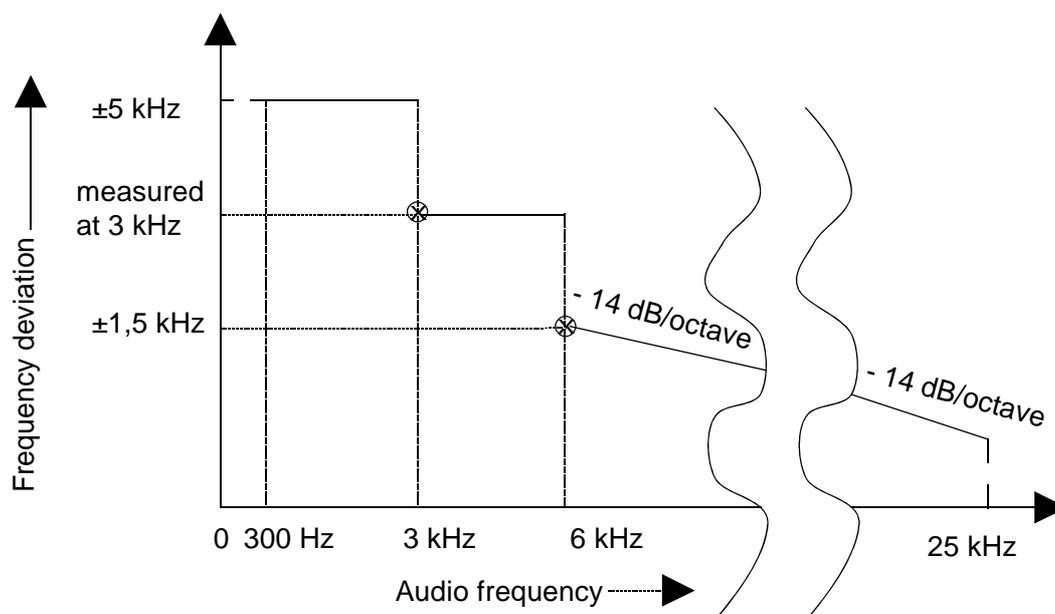


Figure 1: Frequency deviation versus audio modulation frequency

## 8.4 Sensitivity of the modulator, including microphone

### 8.4.1 Definition

This sensitivity expresses the capability of the transmitter to produce sufficient modulation when an audio frequency signal corresponding to the normal mean speech level is applied to the microphone.

### 8.4.2 Method of measurement

An acoustic signal with a frequency of 1 kHz and a sound level of 94 dB relative to  $2 \times 10^{-5}$  Pascal (94 dBA) shall be applied to the microphone. The resulting frequency deviation shall be measured.

### 8.4.3 Limit

The resulting frequency deviation shall be between  $\pm 1,5$  kHz and  $\pm 3$  kHz.

## 8.5 Audio frequency response

### 8.5.1 Definition

The audio frequency response is the frequency deviation of the transmitter as a function of the modulating frequency.

### 8.5.2 Method of measurement

A modulation signal at a frequency of 1 kHz shall be applied to the transmitter audio input. Its level shall be adjusted so that the frequency deviation is  $\pm 1$  kHz. The modulation frequency shall then be varied between 300 Hz and 3 kHz, with the level of the audio frequency signal being kept constant and equal to the value specified above.

### 8.5.3 Limit

The modulation index (ratio of the frequency deviation to the modulation frequency) shall be constant and equal to its value at 1 kHz, within the limits of +1 dB or -3 dB.

## 8.6 Audio frequency harmonic distortion of the emission

### 8.6.1 Definition

The harmonic distortion of the emission modulated by an audio frequency signal is defined as the ratio, expressed as a percentage, of the rms voltage of all the harmonic components of the fundamental frequency to the total rms voltage of the signal after linear demodulation.

### 8.6.2 Method of measurement

The radio frequency signal produced by the transmitter shall be applied via an appropriate coupling device to a linear demodulator with a de-emphasis network of 6 dB per octave.

#### 8.6.2.1 Normal test conditions

Under normal test conditions (see clause 5.3) the radio frequency signal shall be modulated successively at frequencies of 300 Hz and 1 kHz with a constant modulation index of 3.

The distortion of the audio frequency signal shall be measured at all the frequencies specified above.

#### 8.6.2.2 Extreme test conditions

Under extreme test conditions (clauses 5.4.1 and 5.4.2 applied simultaneously), the measurements shall be carried out at 1 kHz with a frequency deviation of  $\pm 3$  kHz.

### 8.6.3 Limit

The harmonic distortion shall not exceed 10 %.

## 8.7 Adjacent channel power

### 8.7.1 Definition

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within a specified pass-band centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

### 8.7.2 Method of measurement

The adjacent channel power shall be measured with a power measuring receiver which conforms to the specifications in annex A (referred to in this and the following clause as the "receiver").

- a) The output of the transmitter shall be linked to the input of the "receiver" by a connecting device such that the impedance presented to the transmitter is  $50 \Omega$  and the level at the "receiver" input is appropriate.
- b) With the transmitter un-modulated (see note), the tuning of the "receiver" shall be adjusted so that a maximum response is obtained. This is the 0 dB response point. The "receiver" attenuator setting and the reading of the meter shall be recorded.
- c) The tuning of the "receiver" shall be adjusted away from the carrier so that the "receiver" -6 dB response nearest to the transmitter carrier frequency is located at a displacement from the nominal carrier frequency of 17 kHz.
- d) The transmitter shall be modulated with 1,25 kHz at a level which is 20 dB higher than that required to produce  $\pm 3$  kHz deviation.
- e) The "receiver" variable attenuator shall be adjusted to obtain the same meter reading as in step b) or a known relation of it.
- f) The ratio of adjacent channel power to carrier power is the difference between the attenuator settings in steps b) and e), corrected for any differences in the reading of the meter.
- g) The measurement shall be repeated with the "receiver" tuned to the other side of the carrier.

NOTE: The measurement may be made with the transmitter modulated with normal test modulation, in which case this fact shall be recorded with the test results.

### 8.7.3 Limit

The adjacent channel power shall not exceed a value of 70 dB below the carrier power of the transmitter without any need to be below 0,2  $\mu$ W.

## 8.8 Conducted spurious emissions conveyed to the antenna

### 8.8.1 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.

### 8.8.2 Method of measurement

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

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

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

### 8.8.3 Limit

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

## 8.9 Cabinet radiation and conducted spurious emissions other than those conveyed to the antenna

### 8.9.1 Definitions

Cabinet radiation consists of emissions at frequencies, radiated by the equipment cabinet and structures.

Conducted spurious emissions other than those conveyed to the antenna are emissions at frequencies, other than those of the carrier and the sideband components resulting from the wanted modulation process, which are produced by conduction in the wiring and accessories used with the equipment.

### 8.9.2 Method of measurement

On a test site, selected from ETSI TS 103 052 [6], 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 transmitter antenna connector shall be connected to on artificial antenna, see clause 6.5.

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 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 transmitter 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 substitution antenna as defined in ETSI TS 103 052 [6];
- 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) the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary;
- 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 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;
- k) the input level to the substitution antenna shall be recorded as power level, corrected for the change of input attenuator setting of the measuring receiver;
- l) the measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization;
- m) the measure of the effective radiated power of the spurious components is larger of the two power levels recorded for spurious component at the input to the substitution antenna, corrected for the gain of the antenna if necessary;
- n) the measurements shall be repeated with the transmitter on stand-by.

### 8.9.3 Limits

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

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

## 8.10 Residual modulation of the transmitter

### 8.10.1 Definition

The residual modulation of the transmitter is the ratio, in dB, of the demodulated RF signal in the absence of wanted modulation, to the demodulated RF signal produced when the normal test modulation is applied.

### 8.10.2 Method of measurement

The normal test modulation defined in clause 6.4 shall be applied to the transmitter. The high frequency signal produced by the transmitter shall be applied, via an appropriate coupling device, to a linear demodulator with a de-emphasis network of 6 dB per octave. The time constant of this de-emphasis network shall be at least 750 µs.

A high pass filter with a cut-off frequency of nominally 100 Hz shall be used to avoid the effects of emphasizing the low audio frequencies produced by internal noise.

The signal shall be measured at the demodulator output using an rms voltmeter.

The modulation shall then be switched off and the level of the residual audio-frequency signal at the output shall be measured again.

### 8.10.3 Limit

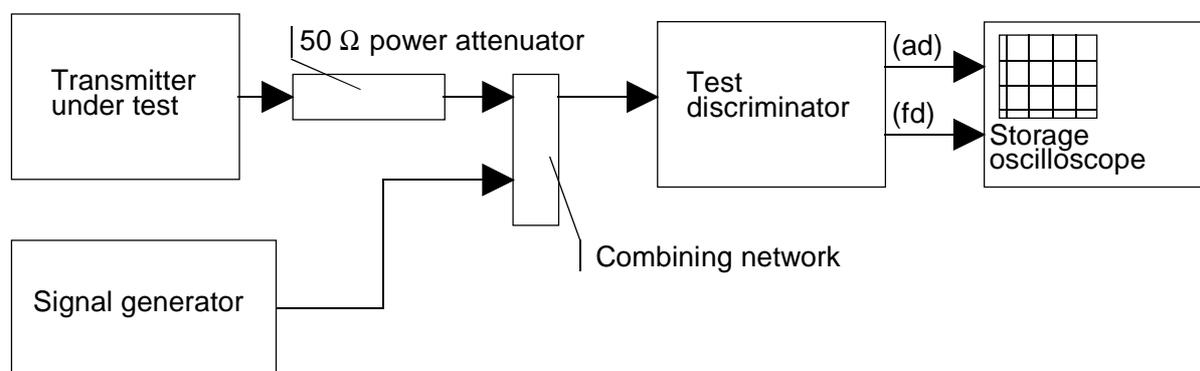
The residual modulation shall not exceed -40 dB.

## 8.11 Transient frequency behaviour of the transmitter

### 8.11.1 Definitions

The transient frequency behaviour of the transmitter is the variation in time of the transmitter frequency difference from the nominal frequency of the transmitter when the RF output power is switched on and off.

### 8.11.2 Method of measurement



**Figure 2: Measurement arrangement**

Two signals shall be connected to the test discriminator via a combining network (see clause 6.2).

The transmitter shall be connected to a 50 Ω power attenuator.

The output of the power attenuator shall be connected to the test discriminator via one input of the combining network.

A test signal generator shall be connected to the second input of the combining network.

The test signal shall be adjusted to the nominal frequency of the transmitter.

The test signal shall be modulated by a frequency of 1 kHz with a deviation of  $\pm 25$  kHz.

The test signal level shall be adjusted to correspond to 0,1 % of the power of the transmitter under test measured at the input of the test discriminator. This level shall be maintained throughout the measurement.

The amplitude difference (ad) (see figure 2) and the frequency difference (fd) (see figure 2) output of the test discriminator shall be connected to a storage oscilloscope.

The storage oscilloscope shall be set to display the channel corresponding to the fd input up to +1 channel frequency difference, corresponding to the relevant channel separation, from the nominal frequency.

The storage oscilloscope shall be set to a sweep rate of 10 ms/division and set so that the triggering occurs at 1 division from the left edge of the display.

The display will show the 1 kHz test signal continuously.

The storage oscilloscope shall then be set to trigger on the channel corresponding to the ad input at a low input level, rising.

The transmitter shall then be switched on, without modulation, to produce the trigger pulse and a picture on the display.

The result of the change in the ratio of power between the test signal and the transmitter output will, due to the capture ratio of the test discriminator, produce two separate sides on the picture, one showing the 1 kHz test signal, the other the frequency difference of the transmitter versus time.

The moment when the 1 kHz test signal is completely suppressed is considered to provide  $t_{\text{on}}$ .

The periods of time  $t_1$  and  $t_2$  as defined in table 1 shall be used to define the appropriate template.

The result shall be recorded as frequency difference versus time.

The transmitter shall remain switched on.

The storage oscilloscope shall be set to trigger on the channel corresponding to the ad input at a high input level, decaying and set so that the triggering occurs at 1 division from the right edge of the display.

The transmitter shall then be switched off.

The moment when the 1 kHz test signal starts to rise is considered to provide  $t_{\text{off}}$ .

The period of time  $t_3$  as defined in table 1 shall be used to define the appropriate template.

The result shall be recorded as frequency difference versus time.

### 8.11.3 Limits

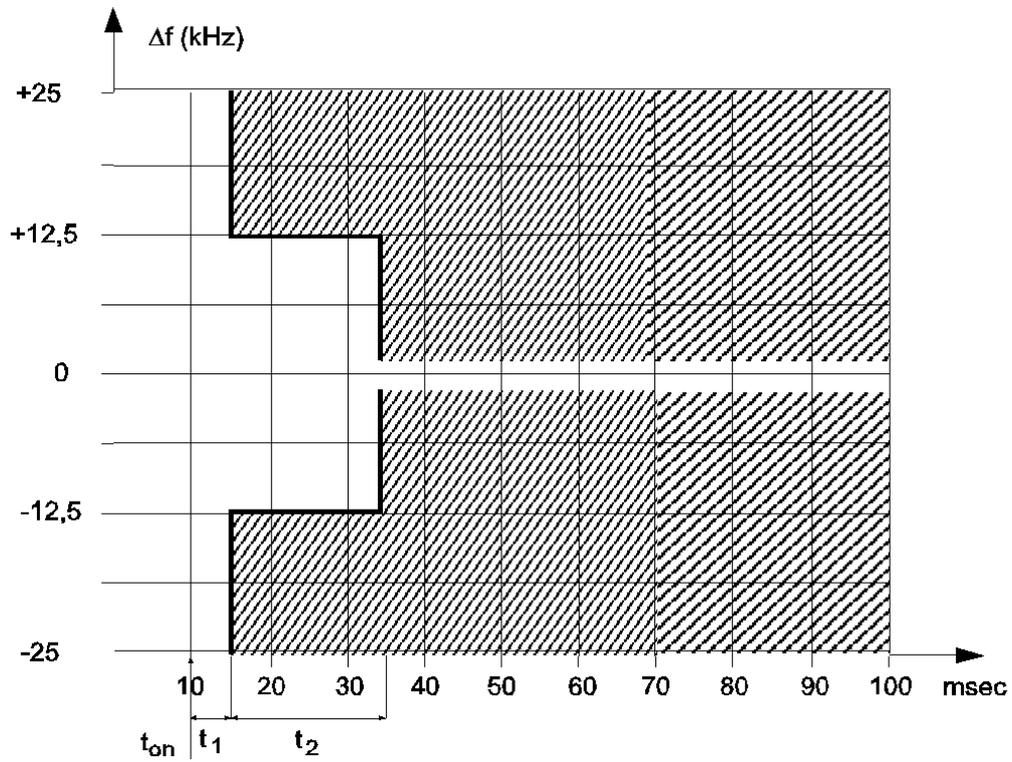
During the periods  $t_1$  and  $t_3$  the frequency difference shall not exceed the value of 1 channel separation. During the period  $t_2$  the frequency difference shall not exceed the value of half a channel separation (see also figure 3).

- $t_{\text{on}}$ : according to the method of measurement described in clause 8.11.2 the switch-on instant  $t_{\text{on}}$  of a transmitter is defined by the condition when the output power, measured at the antenna terminal, exceeds 0,1 % of the nominal power;
- $t_1$ : period of time starting at  $t_{\text{on}}$  and finishing according to table 1;
- $t_2$ : period of time starting at the end of  $t_1$  and finishing according to table 1;
- $t_{\text{off}}$ : switch-off instant defined by the condition when the output power falls below 0,1 % of the nominal power;
- $t_3$ : period of time that finishing at  $t_{\text{off}}$  and starting according to table 1.

**Table 1: Timing**

<b><math>t_1</math> (ms)</b>	5,0
<b><math>t_2</math> (ms)</b>	20,0
<b><math>t_3</math> (ms)</b>	5,0

Switch on condition: limits:  $\Delta f \leq 25$  kHz during  $t_1$  (= 5 msec)  
 $\Delta f \leq 12,5$  kHz during  $t_2$  (= 20 msec)



Switch off condition: limits:  $\Delta f \leq 25$  kHz during  $t_3$  (= 5 msec)

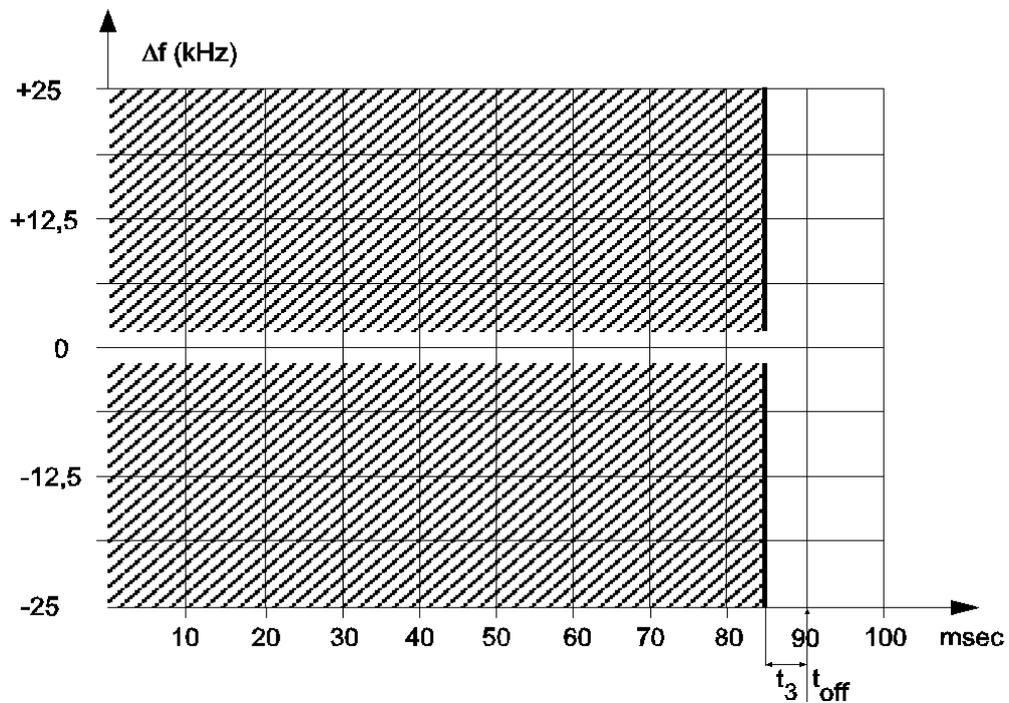


Figure 3: Limits

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## 9 Receiver

### 9.1 Harmonic distortion and rated 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 rated audio-frequency output power is the value stated by the manufacturer to be the maximum power available at the output, for which all the requirements of the present document are met.

#### 9.1.2 Methods of measurement

A test signal at the level of +100 dB $\mu$ V, at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation (see clause 6.4) shall be applied to the receiver input under the conditions specified in clause 6.2.

For each measurement, the receiver's audio frequency volume control shall be set so as to obtain, in a resistive load which simulates the receiver's operating load, the rated audio frequency output power. The value of this load shall be stated by the manufacturer.

Under normal test conditions (see clause 5.3) the test signal shall be modulated successively at 300 Hz and 1 kHz with a constant modulation index of 3 (ratio between the frequency deviation and the modulation frequency). The harmonic distortion and audio frequency output power shall be measured at the frequencies specified above.

Under extreme test conditions (clauses 5.4.1 and 5.4.2 applied simultaneously), the tests shall be made at the receiver's nominal frequency and at the nominal frequency  $\pm 1,5$  kHz. For these tests, the modulation shall be 1 kHz and the frequency deviation shall be  $\pm 3$  kHz.

#### 9.1.3 Limits

The rated audio frequency output power shall be at least:

- 2 W in a loudspeaker;
- 1 mW in the headset earphone if provided.

The harmonic distortion shall not exceed 10 %.

### 9.2 Audio frequency response

#### 9.2.1 Definition

The audio frequency response is the variation in the receiver's audio frequency output level as a function of the modulating frequency of the radio frequency signal with constant deviation applied to its input.

#### 9.2.2 Method of measurement

A test signal of +60 dB $\mu$ V (e.m.f.), at a carrier frequency equal to the nominal frequency of the receiver and modulated with normal test modulation (see clause 6.4), shall be applied to the receiver antenna port under the conditions specified in clause 6.1.

The receiver's audio frequency power control shall be set so as to produce a power level equal to 50 % of the rated output power (see clause 9.1). This setting shall remain unchanged during the test.

The frequency deviation shall then be reduced to 1 kHz and the audio output is the reference point in figure 4 (1 kHz corresponds to 0 dB).

The frequency deviation shall remain constant while the modulation frequency is varied between 300 Hz and 3 kHz and the output level shall then be measured.

The measurement shall be repeated with a test signal at frequencies 1,5 kHz above and below the nominal frequency of the receiver.

### 9.2.3 Limits

The audio frequency response shall not deviate by more than +1 dB; or

3 dB from a characteristic giving the output level as a function of the audio frequency, decreasing by 6 dB per octave and passing through the measured point at 1 kHz (figure 4).

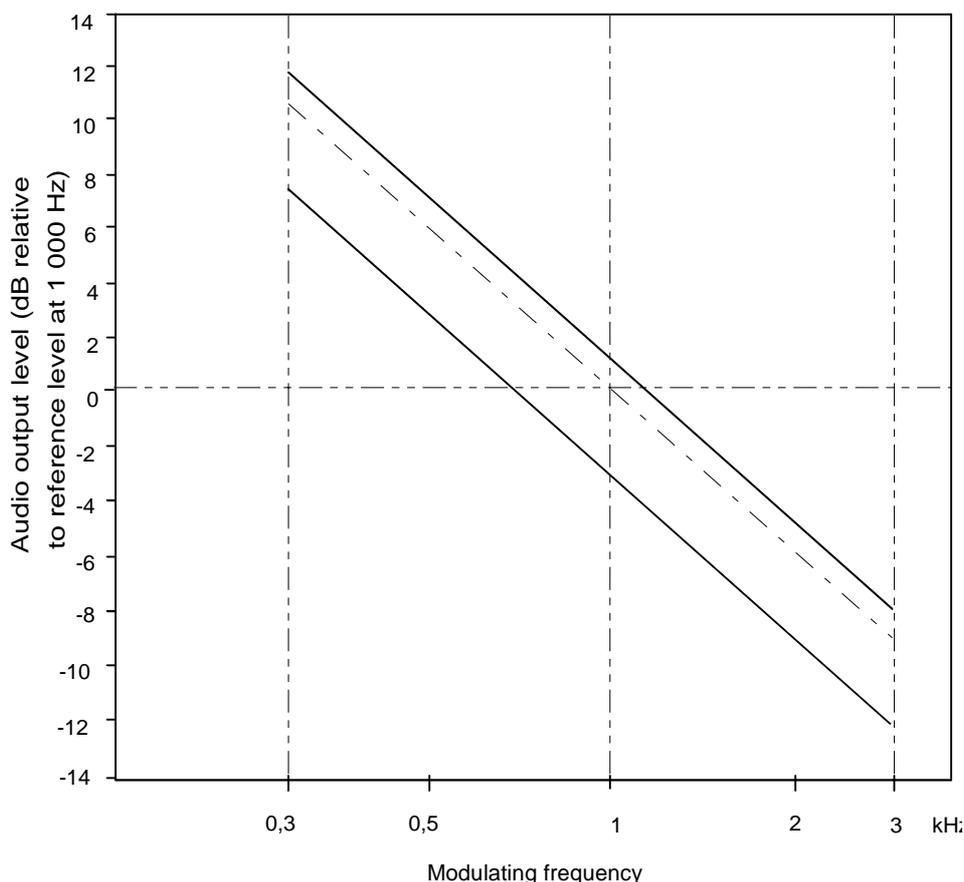


Figure 4: Audio frequency response

## 9.3 Maximum usable sensitivity

### 9.3.1 Definition

The maximum usable sensitivity of the receiver is the minimum level of the signal (emf) at the nominal frequency of the receiver which, when applied to the receiver input with normal test modulation (see clause 6.4) will produce a specified analogue SINAD ratio.

### 9.3.2 Method of measurement

A test signal at a carrier frequency equal to the nominal frequency of the receiver, modulated by the normal test modulation (see clause 6.4) shall be applied to the receiver input. An audio frequency load and a measuring instrument for measuring the SINAD ratio (through a psophometric network and as specified in Recommendation ITU-T O.41 [1]) shall be connected to the receiver audio frequency output.

The level of the test signal shall be adjusted until a SINAD ratio of 20 dB is obtained, using the psophometric network and with the receiver's audio frequency power control adjusted to produce 50 % of the rated audio frequency output power (see clause 9.1). Under these conditions, the level of the test signal at the input is the value of the reference maximum usable sensitivity which shall be recorded.

The measurements shall be made under normal test conditions (see clause 5.3) and under extreme test conditions (clauses 5.4.1 and 5.4.2 applied simultaneously).

A receiver audio frequency output power variation of  $\pm 3$  dB relative to 50 % of the rated audio frequency output power may be allowed for sensitivity measurements under extreme test conditions.

### 9.3.3 Limits

The maximum usable sensitivity shall be less than +6 dB $\mu$ V (emf) under normal test conditions and less than +12 dB $\mu$ V (emf) under extreme conditions.

## 9.4 Co-channel rejection

### 9.4.1 Definition

The co-channel rejection 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 modulated signal, both signals being at the nominal frequency of the receiver.

### 9.4.2 Method of measurement

The two input signals shall be connected to the receiver via a combining network (see clause 6.2). The wanted signal shall have normal test modulation (see clause 6.4). The unwanted signal shall be modulated by 400 Hz with a deviation of  $\pm 3$  kHz. Both input signals shall be at the nominal frequency of the receiver under test and the measurement repeated for displacements of the unwanted signal of  $\pm 3$  kHz.

The wanted input signal shall be set to the value corresponding to the measured maximum usable sensitivity (clause 9.3). The amplitude of the unwanted input signal shall then be adjusted until the SINAD ratio (psophometrically weighted) at the output of the receiver is reduced to 14 dB.

The co-channel rejection ratio shall be expressed as the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input for which the specified reduction in SINAD ratio occurs.

### 9.4.3 Limit

The co-channel rejection ratio shall be between -10 dB and 0 dB.

## 9.5 Adjacent channel selectivity

### 9.5.1 Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by 25 kHz.

### 9.5.2 Method of measurement

The two input signals shall be applied to the receiver input via a combining network (see clause 6.2). The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (see clause 6.4). The unwanted signal shall be modulated by 400 Hz with a deviation of  $\pm 3$  kHz, and shall be at the frequency of the channel immediately above that of the wanted signal.

The wanted input signal shall be set to the value corresponding to the measured maximum usable sensitivity (clause 9.3). The amplitude of the unwanted input signal shall then be adjusted until the SINAD ratio (psophometrically weighted) at the receiver output is reduced to 14 dB. The measurement shall be repeated with an unwanted signal at the frequency of the channel below that of the wanted signal.

The adjacent channel selectivity shall be expressed as the lower value of the ratios in dB for the upper and lower adjacent channels of the level of the unwanted signal to the level of the wanted signal.

The measurements shall then be repeated under extreme test conditions (clauses 5.4.1 and 5.4.2 applied simultaneously) with the wanted signal set to the value corresponding to the reference maximum usable sensitivity under these conditions.

### 9.5.3 Limits

The adjacent channel selectivity shall be not less than 70 dB under normal test conditions and not less than 60 dB under extreme test conditions.

## 9.6 Spurious response rejection

### 9.6.1 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.

### 9.6.2 Method of measurement

Two input signals shall be applied to the receiver input via a combining network (see clause 6.2). The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (see clause 6.4).

The unwanted signal shall be modulated by 400 Hz with a deviation of  $\pm 3$  kHz.

The wanted input signal shall be set to the value corresponding to the measured maximum usable sensitivity (clause 9.3). The amplitude of the unwanted input signal shall be adjusted to an emf of +86 dB $\mu$ V. The frequency shall then be swept over the frequency range from 100 kHz to 2 GHz in steps less than 12,5 kHz. At any frequency at which a response is obtained, the input level shall be adjusted until the SINAD ratio (psophometrically weighted) is reduced to 14 dB.

The spurious response rejection ratio shall be expressed as the ratio in dB between the unwanted signal and the wanted signal at the receiver input when the specified reduction in the SINAD ratio is obtained.

### 9.6.3 Limit

At any frequency separated from the nominal frequency of the receiver by more than 25 kHz, the spurious response rejection ratio shall be not less than 70 dB.

## 9.7 Intermodulation response

### 9.7.1 Definition

The intermodulation response is a measure of the capability of a receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

### 9.7.2 Method of measurement

Three signal generators, A, B and C shall be connected to the receiver via a combining network (see clause 6.2). The wanted signal, represented by signal generator A shall be at the nominal frequency of the receiver and shall have normal test modulation (see clause 6.4). The unwanted signal from signal generator B shall be un-modulated and adjusted to the frequency 50 kHz above (or below) the nominal frequency of the receiver. The second unwanted signal from signal generator C shall be modulated by 400 Hz with a deviation of  $\pm 3$  kHz, and adjusted to a frequency 100 kHz above (or below) the nominal frequency of the receiver.

The wanted input signal shall be set to a value corresponding to the measured maximum usable sensitivity (clause 9.3). The amplitude of the two unwanted signals shall be maintained equal and shall be adjusted until the SINAD ratio (psophometrically weighted) at the receiver audio frequency output is reduced to 14 dB. The frequency of signal generator B shall be adjusted slightly to produce the maximum degradation of the SINAD ratio. The level of the two unwanted test signals shall be readjusted to restore the SINAD ratio of 14 dB.

The intermodulation response ratio shall be expressed as the ratio in dB between the two unwanted signals and the wanted signal at the receiver input, when the specified reduction in the SINAD ratio is obtained.

### 9.7.3 Limit

The intermodulation response ratio shall be not less than 68 dB.

## 9.8 Blocking or desensitization

### 9.8.1 Definition

Blocking is a change (generally a reduction) in the wanted audio frequency output power of the receiver or a reduction of the SINAD ratio due to an unwanted signal on another frequency.

### 9.8.2 Method of measurement

Two input signals shall be applied to the receiver via a combining network (see clause 6.2). The modulated wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (see clause 6.4). Initially the unwanted signal shall be switched off and the wanted signal set to the value corresponding to the measured maximum usable sensitivity (clause 9.3).

The audio frequency output power of the wanted signal shall be adjusted, where possible, to 50 % of the rated audio frequency output power and in the case of stepped volume controls, to the first step that provides an audio frequency output power of at least 50 % of the rated audio frequency output power. The unwanted signal shall be un-modulated at frequencies of  $\pm 1$  MHz,  $\pm 2$  MHz,  $\pm 5$  MHz and  $\pm 10$  MHz relative to the nominal frequency of the receiver. The input level of the unwanted signal, at all frequencies in the specified ranges, shall be adjusted so that the unwanted signal causes:

- a reduction of 3 dB in the audio frequency output level of the wanted signal; or
- a reduction to 14 dB of the SINAD ratio (psophometrically weighted) at the receiver audio frequency output, whichever occurs first. This level shall be noted.

### 9.8.3 Limit

The blocking level for any frequency within the specified ranges, shall be not less than 90 dB $\mu$ V, except at frequencies on which spurious responses are found (see clause 9.6).

## 9.9 Conducted spurious emissions

### 9.9.1 Definition

Conducted spurious emissions from the receiver are components at any frequency, present at the receiver input port.

### 9.9.2 Method of measurement

The level of spurious emissions shall be measured as the power level at the antenna.

Conducted 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  $\Omega$  and the receiver is 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.

The measurements shall extend over the frequency range of 9 kHz to 2 GHz.

### 9.9.3 Limit

The power of any spurious radiation shall not exceed 2 nW at any frequency in the range between 9 kHz and 1 GHz and 20 nW between 1 GHz and 2 GHz.

## 9.10 Radiated spurious emissions

### 9.10.1 Definition

Radiated spurious emissions from the receiver are components at any frequency radiated by the equipment cabinet and the structure.

### 9.10.2 Method of measurements

On a test site, selected from ETSI TS 103 052 [6], 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 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 output of the test antenna shall be connected to a measuring receiver.

The receiver shall be switched on without modulation, and measuring receiver shall be tuned over the frequency range 30 MHz to 2 GHz.

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 receiver 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 receiver shall be replaced by a substitution antenna as defined in ETSI TS 103 052 [6];
- 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) the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary;
- 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 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;
- k) the input level to the substitution antenna shall be recorded as power level, corrected for the change of input attenuator setting of the measuring receiver;
- l) the measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization;
- m) the measure of the effective radiated power of the spurious components is larger of the two power levels recorded for spurious component at the input to the substitution antenna, corrected for the gain of the antenna if necessary.

### 9.10.3 Limit

The power of any spurious radiation shall not exceed 2 nW at any frequency between 30 MHz and 1 GHz and 20 nW between 1 GHz and 2 GHz.

## 9.11 Amplitude response of the receiver limiter

### 9.11.1 Definition

The amplitude response of the receiver limiter is the relationship between the radio frequency input level of a specific modulated signal and the audio frequency level at the receiver output.

### 9.11.2 Method of measurement

A test signal at the nominal frequency of the receiver and modulated by the normal test modulation (clause 6.4) at a level of +6 dB $\mu$ V shall be applied to the receiver input and the audio frequency output level shall be adjusted to a level of 6 dB lower than the rated audio frequency output power (see clause 9.1). The level of the input signal shall be increased to +100 dB $\mu$ V and the audio frequency output level shall be measured again.

### 9.11.3 Limit

The variation between the maximum and minimum value of the audio frequency output level shall not exceed 3 dB.

## 9.12 Receiver noise

### 9.12.1 Definition

The receiver noise is defined as the ratio, in dB, of the audio frequency power of the noise resulting from spurious effects to the audio frequency power produced by a radio frequency signal of average level, modulated by the normal test modulation and applied to the receiver input.

### 9.12.2 Method of measurement

A test signal with a level of +30 dB $\mu$ V emf at a carrier frequency equal to the nominal frequency of the receiver, and modulated by the normal test modulation specified in clause 6.4, shall be applied to the receiver input. An audio frequency load shall be connected to the output terminals of the receiver. The audio frequency power control shall be set so as to produce the rated audio frequency output power level conforming to clause 9.1.

The output signal shall be measured by an rms voltmeter with a -6 dB bandwidth of at least 20 kHz.

The modulation shall then be switched off and the audio frequency output level measured again.

### 9.12.3 Limit

The receiver noise shall not exceed -40 dB relative to the modulated signal.

## 9.13 Squelch operation

### 9.13.1 Definition

The purpose of the squelch facility is to mute the receiver audio output signal when the level of the signal at the receiver input is less than a given value.

### 9.13.2 Method of measurement

The following procedure shall be followed:

- a) with the squelch facility switched off, a test signal of +30 dB $\mu$ V, at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation specified in clause 6.4, shall be applied to the input terminals of the receiver. An audio frequency load and a psophometric filtering network (see clause 9.3.1) shall be connected to the output terminals of the receiver. The receiver's audio frequency power control shall be set so as to produce the rated output power defined in clause 9.1:
  - the output signal shall be measured with the aid of an rms voltmeter;

- the input signal shall then be suppressed, the squelch facility switched on and the audio frequency output level measured again;
- b) with the squelch facility switched off again, a test signal modulated by the normal test modulation shall be applied to the receiver input at a level of +6 dB $\mu$ V (emf) and the receiver shall be set to produce 50 % of the rated output power. The level of the input signal shall then be reduced and the squelch facility shall be switched on. The input signal shall then be increased until the above-mentioned output power is reached. The SINAD ratio and the input level shall then be measured;
- c) (applicable only to equipment with continuously adjustable squelch control) with the squelch facility switched off, a test signal with normal test modulation shall be applied to the receiver input at a level of +6 dB $\mu$ V (emf), and the receiver shall be adjusted to give 50 % of the rated audio output power. The level of the input signal shall then be reduced and the squelch facility shall be switched on. The squelch shall then be at its maximum position and the level of the input signal increased until the output power again is 50 % of the rated audio output power.

### 9.13.3 Limits

Under the conditions specified in a) clause 9.13.2, the audio frequency output power shall not exceed -40 dB relative to the rated output power.

Under the conditions specified in b) clause 9.13.2, the input level shall not exceed +6 dB $\mu$ V (emf) and the SINAD ratio shall be at least 20 dB.

Under the conditions specified in c) clause 9.13.2, the input signal shall not exceed +6 dB $\mu$ V (emf) when the control is set at maximum.

## 9.14 Squelch hysteresis

### 9.14.1 Definition

Squelch hysteresis is the difference in dB between the receiver input signal levels at which the squelch opens and closes.

### 9.14.2 Method of measurement

If there is any squelch control on the exterior of the equipment it shall be placed in its maximum muted position. With the squelch facility switched on, an unmodulated input signal at a carrier frequency equal to the nominal frequency of the receiver shall be applied to the input of the receiver at a level sufficiently low to avoid opening the squelch. The input signal shall be increased to the level just opening the squelch. This input level shall be recorded. With the squelch still open, the level of the input signal shall be slowly decreased until the squelch mutes the receiver audio output again.

### 9.14.3 Limit

The squelch hysteresis shall be between 3 dB and 6 dB.

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## 10 Secondary battery charger

### 10.1 General

If the equipment is powered by a secondary battery, the associated battery charger shall be submitted for conformance testing with the equipment.

The charger shall:

- have an indication to show that it is charging;
- have means to indicate when each battery has reached the fully charged condition;
- be able to fully charge discharged batteries in no more than 14 hours;

- automatically maintain fully charged batteries in a fully charged condition as long as the batteries remain in the charger.

## 10.2 Environmental tests

### 10.2.1 Introduction

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

The following tests shall be conducted in the order in which they appear. After being subjected to the various environmental conditions, the charger shall meet the requirements specified in clause 10.3.

### 10.2.2 Vibration test

#### 10.2.2.1 Definition

This test determines the ability of equipment to withstand vibration without resulting in mechanical weakness or degradation in performance.

#### 10.2.2.2 Method of measurement

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the vibration table by its normal means of support and in its normal attitude. The EUT may be resiliently suspended to compensate for weight not capable of being withstood by the vibration table. Provision may be made to reduce or nullify any adverse effect on EUT performance which could be caused by the presence of an electro-magnetic field due to the vibration unit.

The EUT shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 5 Hz and up to 13,2 Hz with an excursion of  $\pm 1 \text{ mm} \pm 10 \%$  ( $7 \text{ m/s}^2$  maximum acceleration at 13,2 Hz);
- above 13,2 Hz and up to 100 Hz with a constant maximum acceleration of  $7 \text{ m/s}^2$ .

The frequency sweep rate shall be slow enough to allow the detection of resonances in any part of the EUT.

A resonance search shall be carried out throughout the test. If any resonance of the EUT has  $Q \geq 5$  measured relative to the base of the vibration table, the EUT shall be subjected to a further vibration endurance test at each resonant frequency at the vibration level specified in the test with a duration of two hours. If any resonance with  $Q < 5$  occurs the further endurance test shall be carried out at one single observed frequency. If no resonance occurred, the further endurance test shall be carried out at a frequency of 30 Hz.

The procedure shall be repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

After conducting the vibration tests, the equipment shall be inspected for any mechanical deterioration.

#### 10.2.2.3 Requirement

During vibration, any battery or equipment which it is designed to hold shall remain in position, and continue to be charged. There shall be no harmful deterioration of the charger, or battery or equipment which it is designed to hold, visible to the naked eye.

### 10.2.3 Shock tests

#### 10.2.3.1 Definition

This test determines the ability of equipment to withstand mechanical shock.

#### 10.2.3.2 Method of measurement

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the table of the shock testing machine by its normal means of support and in its normal attitude.

The shock applied to the equipment shall consist of a pulse being one half-cycle of a sine wave in accordance with IEC 60068-2-27 [2].

The peak acceleration shall be 30 g and the duration shall be 18 ms.

Three successive shocks shall be applied in each direction of the three mutually perpendicular axes of the EUT.

After the test, the equipment shall be inspected for any mechanical deterioration.

### 10.2.3.3 Requirement

During the shock tests, any battery or equipment which it is designed to hold shall remain in position, and continue to be charged. There shall be no harmful deterioration of the charger, or battery or equipment which it is designed to hold, visible to the naked eye.

## 10.2.4 Temperature tests

### 10.2.4.1 General

The tests to be carried out on the charger are described in the following paragraphs. The maximum rate of raising or reducing the temperature of the chamber in which the equipment is being tested shall be 1 °C/minute.

### 10.2.4.2 Dry heat cycle

The charger shall be placed in a chamber of normal room temperature. Then the temperature shall be raised to and maintained at +55 °C ( $\pm 3$  °C) for a period of at least 10 hours.

After this period any climatic control device provided in the charger may be switched on.

30 minutes later, the charger shall be switched on, and shall then be kept working continuously for a period of 2 hours.

The temperature of the chamber shall be maintained at +55 °C ( $\pm 3$  °C) during the 2 hours 30 minutes period.

At the end of the test, and with the charger still in the chamber, the chamber shall be brought to room temperature in not less than 1 hour.

The charger shall then be exposed to normal room temperature and humidity for not less than 3 hours before the next test is carried out.

### 10.2.4.3 Damp heat cycle

The charger shall be placed in a chamber at normal room temperature and humidity which, steadily, over a period of 3 hours ( $\pm 0,5$  hours), shall be heated from room temperature to +40 °C ( $\pm 3$  °C) and shall during this period be brought to a relative humidity of 93 % ( $\pm 2$  %) so that excessive condensation is avoided.

These conditions shall be maintained for a period of at least 10 hours.

After this period, any climatic control devices provided within the charger may be switched on.

30 minutes later the charger shall be switched on, and shall then be kept working continuously for a period of 2 hours.

The temperature and relative humidity of the chamber shall be maintained at +40 °C ( $\pm 3$  °C) and 93 % ( $\pm 2$  %) during the 2 hours 30 minutes period.

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

### 10.2.4.4 Low temperature cycle

The charger shall be placed in a chamber at normal room temperature. Then the temperature shall be reduced to, and maintained at, -15 °C ( $\pm 3$  °C) for a period of at least 10 hours.

After this period, any climatic control devices and/or heat sources provided in the charger may be switched on.

At the end of the test, and with the charger 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.

## 10.2.5 Corrosion test

### 10.2.5.1 General

This test may be omitted if sufficient evidence is provided by the manufacturer that the corresponding requirements of this clause are met.

### 10.2.5.2 Method of measurement

The charger shall be placed in a chamber fitted with apparatus capable of spraying in the form of fine mist, such as would be produced by a spray gun, salt solution to the following formula:

- sodium chloride: 26,5 grammes  $\pm$  10 %;
- magnesium chloride: 2,5 grammes  $\pm$  10 %;
- magnesium sulphate: 3,3 grammes  $\pm$  10 %;
- calcium chloride: 1,1 grammes  $\pm$  10 %;
- potassium chloride: 0,73 grammes  $\pm$  10 %;
- sodium bicarbonate: 0,20 grammes  $\pm$  10 %;
- sodium bromide: 0,28 grammes  $\pm$  10 %;

plus distilled water to make the solution up to 1 litre.

Alternatively a 5 % sodium chloride (NaCl) solution may be used.

The salt used for the test shall be high quality sodium chloride (NaCl) containing, when dry, not more than 0,1 % sodium iodide and not more than 0,3 % of total impurities.

Salt solution concentration shall be 5 ( $\pm$ 1) % by weight.

The solution shall be prepared by dissolving 5 parts  $\pm$ 1 by weight of salt in 95 parts by weight of distilled or de-mineralized water.

The pH value of the solution shall be between 6,5 and 7,2 at temperature of 20 °C ( $\pm$ 2 °C). The pH value shall be maintained within this range during conditioning; for this purpose, diluted hydrochloric acid or sodium hydroxide may be used to adjust the pH value, provided that the concentration of NaCl remains within the prescribed limits. The pH value shall be measured when preparing each new batch of solution.

The spraying apparatus shall be such that the products of corrosion cannot mix with the salt solution contained within the spray reservoir.

The charger shall be sprayed simultaneously on all its external surfaces with the salt solution for a period of 1 hour.

This spraying shall be carried out 4 times with a storage period of 7 days at +40 °C ( $\pm$ 2 °C) after each spraying. The relative humidity during storage shall be maintained between 90 % and 95 %.

At the end of the total period the charger shall be examined visually.

### 10.2.5.3 Requirements

There shall be no undue deterioration or corrosion of the metal parts, finishes, material, or component parts visible to the naked eye.

## 10.3 Charging time

Place a fully discharged battery in the charger and record the time taken until the fully charged indication is achieved. This time shall not exceed 14 hours. Remove the battery from the charger and perform the test detailed in clause 4.7.

## Annex A (normative): Measuring receiver for adjacent channel power measurement

### A.1 Power measuring receiver specification

#### A.1.0 Description

The power measuring receiver consists of a mixer, an Intermediate Frequency (IF) filter, an oscillator, an amplifier, a variable attenuator and an rms value indicator. Instead of the variable attenuator with the rms value indicator it is also possible to use an rms voltmeter calibrated in dB. The technical characteristics of the power measuring receiver are given in clause A.1.1.

#### A.1.1 IF filter

The IF filter shall be within the limits of the following selectivity characteristics given in figure A.1.

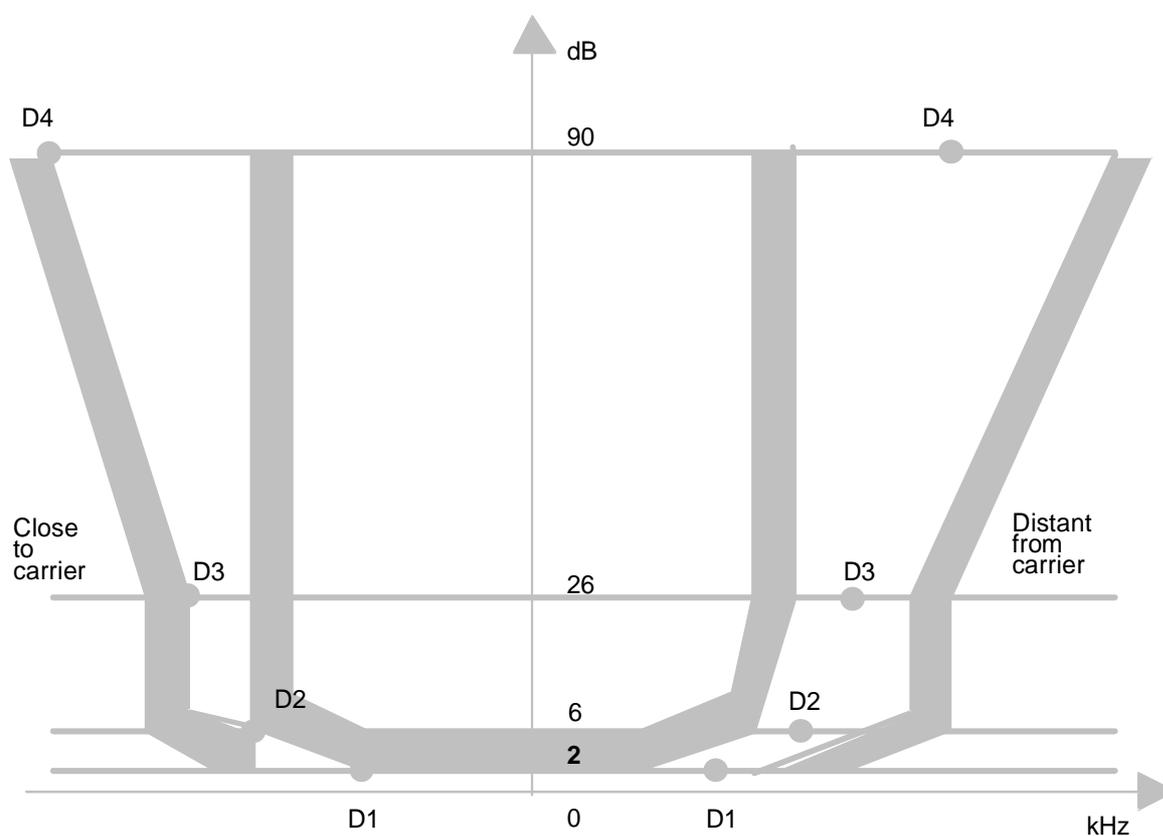


Figure A.1

The selectivity characteristics shall keep the following frequency separations from the nominal centre frequency of the adjacent channel given in table A.1.

Table A.1: Selectivity characteristic

Frequency separation of filter curve from nominal centre frequency of adjacent channel (kHz)			
D1	D2	D3	D4
5	8,0	9,25	13,25

The attenuation points shall not exceed the following tolerances given in tables A.2 and A.3.

**Table A.2: Attenuation points close to carrier**

Tolerance range (kHz)			
D1	D2	D3	D4
+3,1	±0,1	-1,35	-5,35

**Table A.3: Attenuation points distant from the carrier**

Tolerance range (kHz)			
D1	D2	D3	D4
±3,5	±3,5	±3,5	+3,5 -7,5

The minimum attenuation of the filter outside the 90 dB attenuation points shall be equal to or greater than 90 dB.

## A.1.2 Attenuation indicator

The attenuation indicator shall have a minimum range of 80 dB and a reading accuracy of 1 dB. With a view to future regulations an attenuation of 90 dB or more is recommended.

## A.1.3 rms value indicator

The instrument shall accurately indicate non-sinusoidal signals in a ratio of up to 10 : 1 between peak value and rms value.

## A.1.4 Oscillator and amplifier

The oscillator and the amplifier shall be designed in such a way that the measurement of the adjacent channel power of a low-noise un-modulated transmitter, whose self-noise has a negligible influence on the measurement result, yields a measured value of  $\leq -90$  dB.

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## History

<b>Document history</b>		
V1.1.1	October 2000	Publication
V1.2.0	August 2015	EN Approval Procedure AP 20151205: 2015-08-07 to 2015-12-07
V1.2.1	December 2015	Publication