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Foreword

This European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI), and was adopted, having passed through the ETSI standards approval procedure, (Public Enquiry 19: 1991-05-13 to 1991-10-04, Vote 27: 1992-09-21 to 1992-11-13).

This ETS lays down minimum requirements for VHF radio transmitters and receivers operating on board ships in certain frequency bands allocated to the maritime mobile service, and incorporates the requirements of the relevant recommendations of the International Maritime Organization.

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1 Scope

This ETS states the minimum requirements for VHF transmitters and receivers fitted with a 50 Ω external antenna socket or connector for use on board ships and operating in the bands between 156 and 174 MHz allocated to the maritime mobile service by the Radio Regulations [1)] (see Radio Regulations, Appendices 18 [1] and 19 [2]). The relevant requirements detailed in the references in Clause 2, Normative References are incorporated in this ETS.

2 Normative references

This ETS incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent references to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] Radio Regulations, Appendix 18 (1990): "Table of Transmitting frequencies in the band 156-174 MHz for Stations in the Maritime Mobile Service".

[2] Radio Regulations, Appendix 19 (1990): "Technical Characteristics for Transmitters and Receivers used in the Maritime Mobile Service in the band 156-174 MHz".

[3] CCITT Recommendation E.161 (1988): "Arrangement of figures, letters and symbols on telephones and other devices that can be used for access to a telephone network".

[4] CEPT Recommendation T/R 34-01: "Specifications for Maritime Mobile Radio equipment".

[5] CCITT Recommendation P.53 (1988): "Psophometric apparatus for the objective measurement of circuit noise".

[6] International Convention on Safety of Life at Sea.

[7] CISPR Publication 16 (1987): "CISPR specification for radio interference measuring apparatus and measuring methods".

[8] NMEA 0183 Version 2.00: "Standard for interfacing marine electronic devices".

3 General requirements

3.1 Construction

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 on board ships.

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1) Use in certain inland waterways may impose additional requirements.

All controls shall be of sufficient size to enable the usual control functions to be easily performed and the number of controls should be the minimum necessary for simple and satisfactory operation.

All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible. The components shall be readily identifiable.

Full technical documentation shall be supplied with the equipment.

The VHF maritime mobile service uses both single-frequency and two-frequency channels. For two-frequency channels the Radio Regulations require a separation of 4,6 MHz between the transmitting frequency and the receiving frequency.

The equipment shall be capable of operating on single frequency and two-frequency channels with manual control (simplex). It may also be capable of operating on two-frequency channels without manual control (duplex).

The equipment shall be able to operate on all channels defined in Appendix 18 to the Radio Regulations [1].

Operation on channels 75 and 76 shall be prevented by appropriate means. Additional VHF channels outside those defined by Appendix 18 to the Radio Regulations [1] may also be provided, but means shall be provided to block any or all of these additional channels, as may be required by an Administration, before installation on board ships. It shall not be possible for the user to unblock or block these additional channels.

The equipment shall be so designed that use of channel 70 for purposes other than Digital Selective Calling (DSC) is prevented.

It shall not be possible to transmit while any frequency syntheziser used within the transmitter is out of lock.

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

3.2 Controls and indicators

The equipment shall have a channel selector and shall indicate the designator, as shown in Appendix 18 to the Radio Regulations [1], of the channel at which the installation is set. The channel designator shall be legible irrespective of the external lighting conditions.

Where practicable, channels 16 and 70 should be distinctively marked. Selection of channel 16, and if possible channel 70, shall preferably be by readily accessible means (e.g. a distinctively marked key). Where an input panel on the equipment for entering the digits 0 - 9 is provided, this shall conform to CCITT Recommendation E.161 [3].

The equipment shall have the following additional controls and indicators:

- on/off switch for the entire installation with a visual indication that the installation is in operation;
- a manual non-locking push to talk switch to operate the transmitter;
- on/off switch for the loudspeaker;
- a switch for reducing transmitter output power to no more than 1 W;
- an audio frequency power volume control;
- a squelch control;
- a control for reducing the brightness of the equipment illumination to zero;
- an output power detector giving a visual indication that the carrier is being produced.

The equipment shall also meet the following requirements:

- the user shall not have access to any control which, if wrongly set, might impair the technical characteristics of the equipment;
- if the accessible controls are located on a separate console and if there are two or more control consoles, one of the consoles shall have priority over the others. If there are two or more control consoles, the operation of one console shall be indicated on the other consoles.

3.3 Handset and loudspeaker

The equipment shall be fitted with a telephone handset or microphone, and an integral loudspeaker and/or a socket for an external loudspeaker. A handset is required if duplex operation is provided.

It shall be possible to switch off the loudspeaker without causing a variation in the audio frequency power provided to the handset, if supplied.

During transmission in simplex operation the receiver output shall be muted.

During transmission in duplex operation only the handset shall be operative. Measures shall be taken to ensure correct operation when duplex is used and precautions shall be taken to prevent harmful electrical or acoustic feedback which might produce oscillations.

3.4 Switching time

The channel switching arrangement 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 s.

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

3.5 Safety precautions

Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage.

Measures shall be taken to prevent damage to the equipment if the electrical power source produces transient voltage variations and to prevent any damage that might arise from an accidental reversal of polarity of the electrical power source.

Means shall be provided for earthing exposed metallic parts of the equipment but this shall not cause any terminal of the source of electrical energy to be earthed.

All components and wiring in which the dc or ac voltage (other than radio-frequency voltage), produce, singly or in combination, peak voltages in excess of 50 V, shall be protected against any accidental access and shall be automatically isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

No damage to the equipment shall occur when the antenna terminals are placed on open circuit or short circuit for a period of at least 5 min in each case.

In order to provide protection against damage due to the build up of static voltages at the antenna terminals, there shall be a dc path from the antenna terminals to chassis not exceeding 100 K Ω.

The information in any volatile memory device shall be protected from interruptions in the power supply of up to 60 s duration.

3.6 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, and G2B for DSC signalling where provided.

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

The frequency deviation corresponding to 100 % modulation shall be ± 5 kHz as nearly as practicable.

3.7 Multiple watch facilities

3.7.1 Additional performance standards

VHF radiotelephone equipment having multiple watch facilities shall comply with the following additional performance standards:

1) the equipment shall include a provision for the automatic scanning of a priority channel and one additional channel. Facilities for the automatic sequential change of the additional channel may be provided, which are not accessible to the user. Means shall be provided to block/unblock these facilities, at the request of an Administration;

2) the priority channel is that channel which will be sampled even if there is a signal on the additional channel and on which the receiver will lock during the time a signal is detected;

3) the additional channel is that channel which will be monitored during the periods the equipment is not sampling or receiving signals on the priority channel;

4) provision shall be included to switch the scanning facility on and off by means of a manually operated control. In addition it shall be ensured that the receiver remains on the same channel as the transmitter for the entire duration of any communication with the ship, e.g. the scanning facility could be switched off automatically when the handset is off its hook;

5) selection of the additional channel and selection, if provided, of the priority channel shall be possible at the operating position of the receiver or transceiver. If selection of the priority channel is not provided, the priority channel shall be channel 16 unless an Administration considers that an alternative channel should be watched in a particular area;

6) when the scanning facility is in operation, the channel number of both channels on which the equipment is operating shall be clearly indicated simultaneously;

7) in a transceiver, transmission shall not be possible when the scanning facility is operating. When the scanning facility is switched off, both transmitter and receiver shall be tuned automatically to the selected additional channel;

8) a transceiver shall be provided with a single manual control (e.g. push-button) in order to switch the equipment quickly for operation on the priority channel;

9) at the operating position of a transceiver the selected additional channel shall be clearly indicated as being the operational channel of the equipment.

3.7.2 Scanning characteristics

When the scanning facility is switched on, the priority channel shall be sampled with a sampling period of not more than 2 s. If a signal is detected on the priority channel the receiver shall remain on this channel for the duration of that signal.

If a signal is detected on the additional channel the sampling of the priority channel shall continue, thus interrupting the reception on the channel for periods as short as possible and not greater than 150 ms.

The design of the receiver shall provide for its proper functioning during the period the priority channel is sampled since the receiving conditions on the priority channel may differ from those on the additional channel.

In the absence of a signal on the priority channel, and, during reception of a signal on the additional channel, the duration of each listening period on this channel shall be at least 850 ms.

Means shall be provided to indicate the channel on which a signal is being received.

3.8 Facilities for DSC transmission and reception

VHF transmitters and receivers with an integral DSC modem or to be used with an external DSC modem shall also be tested in accordance with the standard for DSC equipment (presently contained in CEPT Recommendation T/R 34-01 Annex XIII [4]).

VHF transmitters and receivers to be used for DSC shall also comply with the following:

1) the DSC facility shall be capable of operating on at least channel 70;

2) if the equipment is designed for connection of an external modem to the audio frequency terminals, the input and output impedances should be 600 Ω free of earth;

3) if the equipment is designed for connection to an external DSC modem with binary inputs and outputs for DSC signals, the logic level and the appropriate functions shall comply with NMEA 0183 Version 2.00 [8].

3.9 Labelling

All controls, instruments, indicators and terminals shall be clearly labelled.

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

All units of the equipment shall be clearly marked on the exterior with the identification of the manufacturer, type designation of the equipment, and the serial number of the unit. This marking shall be clearly visible in the normal operating position.

The compass safe distance shall be stated on the equipment or in the technical manual.

3.10 Warm up

After being switched on the equipment shall be operational within 5 s and shall meet the requirements of this ETS within 1 min.

4 Test conditions, power sources and ambient temperatures

4.1 Normal and extreme test conditions

Conformance tests shall be made under normal test conditions and also, where stated, under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously).

4.2 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 subclauses 4.3.2 and 4.4.2.

The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of 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 ± 3 % relative to the voltage level at the beginning of each test.

4.3 Normal test conditions

4.3.1 Normal temperature and humidity

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

temperature: + 15°C to + 35°C;

relative humidity: 20 % to 75 %.

4.3.2 Normal power sources

4.3.2.1 Mains voltage and frequency

The normal test voltage for equipment to be connected to the ac mains shall be the nominal mains voltage. For the purpose of this ETS, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment is indicated as having been designed. The frequency of the test voltage shall be 50 Hz ± 1 Hz.

4.3.2.2 Battery power source

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

4.3.2.3 Other power sources

For operation from other power sources the normal test voltage shall be that declared by the manufacturer.

4.4 Extreme test conditions

4.4.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with subclause 4.5, at a lower temperature of - 15°C and an upper temperature of + 55°C.

4.4.2 Extreme values of test power sources

4.4.2.1 Mains voltage

The extreme test voltages for equipment to be connected to the ac mains shall be the nominal mains voltage ± 10 %.

4.4.2.2 Battery power source

Where the equipment is designed to operate from a battery, the extreme test voltages shall be 1,3 and 0,9 times the nominal voltage of the battery (12 V, 24 V, etc.).

4.4.2.3 Other power sources

For operation from other power sources the extreme test voltages shall be agreed between the testing authority and the equipment manufacturer.

4.5 Procedure for tests at extreme temperatures

The equipment shall be switched off during the temperature stabilising 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 in the high power transmit condition; the equipment shall meet the standard 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 standard.

4.6 Environmental tests

Environmental tests shall be carried out before any other tests. Where electrical tests are required, these shall be done with normal test voltage (subclause 4.3.2) unless otherwise stated.

Where the term "performance check" is used, this means a visual inspection, a comparative test of output RF power, transmitter frequency accuracy and receiver sensitivity to show that the equipment is functioning and that there is no visible damage or deterioration.

The following tests shall be made under the environmental conditions detailed in the standard for Environmental testing of maritime radio equipment presently contained in CEPT Recommendation T/R 34-01 Annex VI [4].

Vibration, Clause 4.

Dry-heat cycle, subclause 5.2.

Damp-heat cycle, Clause 6.

Low-temperature cycle, subclause 7.2.

4.7 Extended usage tests

The following extended usage tests shall be made under normal test conditions only:

- four 30-minute periods of transmission in the high power condition separated by 5-minute periods of reception only.

The other tests in this ETS shall then be conducted in order to verify whether the equipment meets all the technical requirements mentioned in Clauses 5, 6, 7 and 8.

5 General conditions of measurement

5.1 Arrangements for test signals applied to the receiver input

Test signal sources 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 emf at the terminals to be connected to the receiver.

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

5.2 Squelch

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

5.3 Normal test modulation

For normal test modulation, the modulation frequency shall be 1 kHz and the frequency deviation shall be ± 3 kHz.

The test signal shall be substantially free from spurious amplitude modulation.

5.4 Artificial antenna

When tests are carried out with an artificial antenna, this shall be a non-reactive, non-radiating 50 Ω load. Conformance tests of RF characteristics are performed using an artificial antenna, however the manufacturer should be aware that normally used VHF antennas when installed, although presenting a nominal impedance of 50 Ω, may exhibit VSWRs up to 2:1 depending on the frequency in use. Under such conditions the equipment is required to function correctly.

5.5 Arrangements for test signals applied to the transmitter input

For the purpose of this ETS, the audio frequency modulating signal applied to the transmitter shall be produced by a signal generator applied to the connection terminals replacing the microphone transducer.

5.6 Tests on equipment with a duplex filter

If the equipment has an integral duplex filter or a separate associated duplex filter, the characteristics of this ETS shall be met, with the measurements carried out using the antenna terminals of the filter.

5.7 Test channels

Conformity tests shall be made on at least the highest frequency and the lowest frequency within the equipment's frequency band, and on channel 16.

5.8 Measurement uncertainty and interpretation of the measured results

5.8.1 Measurement uncertainty

Absolute measurement uncertainties: maximum values

Table 1

RF frequency	± 1 x 10^{-7}
RF power	± 0,75 dB
Maximum frequency deviation: - within 300 Hz to 6 kHz of audio frequency - within 6 kHz to 25 kHz of audio frequency	 ± 5 % ± 3 dB
Deviation limitation	± 5 %
Adjacent channel power	± 5 dB
Conducted spurious emission of transmitter	± 4 dB
Audio output power	± 0,5 dB
Amplitude characteristics of receiver limiter	± 1,5 dB
Sensitivity at 20 dB SINAD	± 3 dB
Conducted emission of receiver	± 3 dB
Two-signal measurement	± 4 dB
Three-signal measurement	± 3 dB
Radiated emission of transmitter	± 6 dB
Radiated emission of receiver	± 6 dB
Transmitter transient time	± 20 %
Transmitter transient frequency	± 250 Hz
Receiver desensitisation (duplex operation)	± 0,5 dB

For the test methods according to this ETS the uncertainty figures are valid to a confidence level of 95 % calculated according to the methods described in ETR 028: "Uncertainties in the measurement of Mobile radio equipment characteristics".

5.8.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in this ETS 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 standard;

- 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 figures in table 1 above.

NOTE: This procedure for using maximum acceptable uncertainty values is valid until superseded by other appropriate publications of ETSI covering this subject.

The use of the measured value has been chosen because there is no other ETSI standard covering the subject at the time of publication of this ETS. Therefore the measurement uncertainty shall be used as a quality of the actual measurement. The measurement uncertainty values can also be used by Accreditation Authorities during their accreditation procedures to ensure compliance/conformity with the requirements of type testing to ETSI standards.

6 Transmitter

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

6.1 Frequency error

6.1.1 Definition

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

6.1.2 Method of measurement

The carrier frequency shall be measured in the absence of modulation, with the transmitter connected to an artificial antenna (subclause 5.4). Measurements shall be made under normal test conditions (subclause 4.3) and under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously).

This test shall be carried out with the output power switch being set at both maximum and minimum.

6.1.3 Limits

The frequency error shall be within ± 1,5 kHz.

6.2 Carrier power

6.2.1 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.

6.2.2 Method of measurement

The transmitter shall be connected to an artificial antenna (subclause 5.4) and the power delivered to this artificial antenna shall be measured. The measurements shall be made under normal test conditions (subclause 4.3) and under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously).

6.2.3 Limits

6.2.3.1 Normal test conditions

The carrier power measured under normal test conditions with the output power switch (subclause 3.2) set at maximum, shall remain between 6 W and 25 W and not differ by more than ± 1,5 dB from the rated output power.

6.2.3.2 Extreme test conditions

With the output power switch set at maximum, the carrier power shall remain between 6 W and 25 W and be within + 2 dB, - 3 dB of the rated output power under extreme conditions.

With the output power switch set at minimum, the carrier power shall remain between 0,1 W and 1 W.

6.3 Frequency deviation

6.3.1 Definition

For the purpose of this ETS, the frequency deviation is the difference between the instantaneous frequency of the modulated radio frequency signal and the carrier frequency.

6.3.2 Maximum permissible frequency deviation

6.3.2.1 Method of measurement

The frequency deviation shall be measured at the output with the transmitter connected to an artificial antenna (subclause 5.4), 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 (subclause 5.3). This test shall be carried out with the output power switch set at both maximum and minimum.

6.3.2.2 Limits

The maximum permissible frequency deviation shall be ± 5 kHz.

6.3.3 Reduction of frequency deviation at modulation frequencies above 3 kHz

6.3.3.1 Method of measurement

The transmitter shall operate under normal test conditions (subclause 4.3) connected to a load as specified in subclause 5.4. The transmitter shall be modulated by the normal test modulation (subclause 5.3). 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.

6.3.3.2 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 ± 1,5 kHz, as shown in figure 1.

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 ± 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.

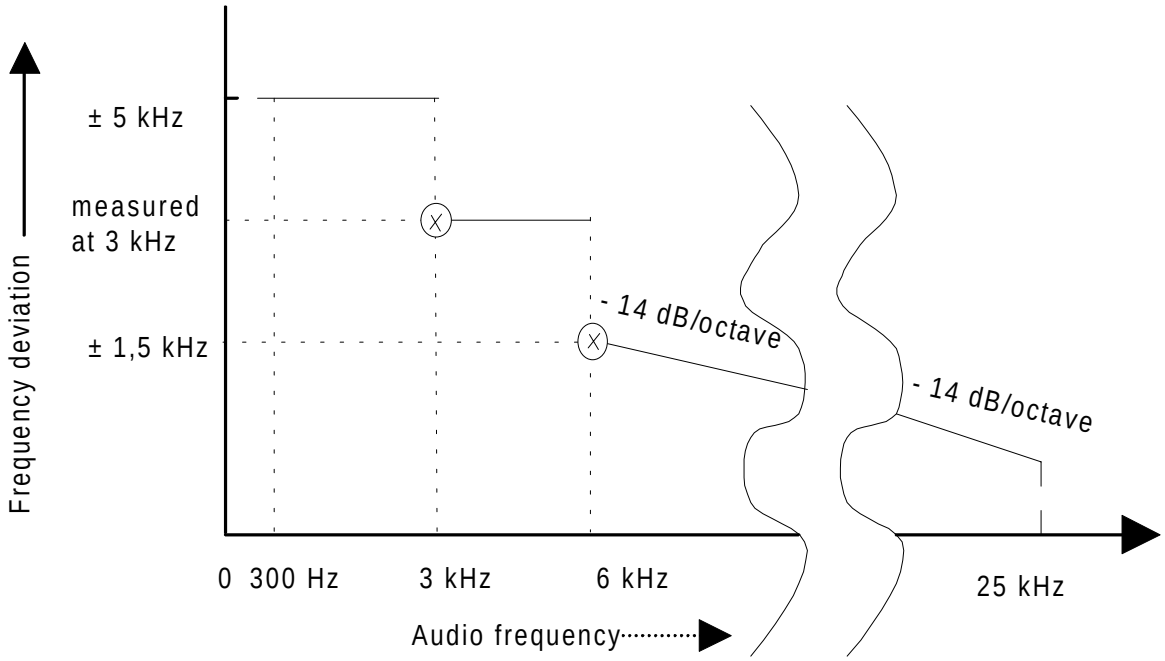

Figure 1

6.4 Limitation characteristics of the modulator

6.4.1 Definition

This characteristic expresses the capability of the transmitter of being modulated with a deviation approaching the maximum permissible deviation specified in subclause 6.3.2.

6.4.2 Method of measurement

A modulation signal at a frequency of 1 kHz shall be applied to the transmitter, and its level adjusted so that the frequency deviation is ± 1 kHz. The level of the modulation signal shall then be increased by 20 dB and the deviation shall again be measured. This test shall be conducted under normal test conditions (subclause 4.3) and under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously).

This test shall be carried out with the output power switch being set at both maximum and minimum.

6.4.3 Limits

The frequency deviation shall be contained between ± 3,5 kHz and ± 5 kHz.

6.5 Sensitivity of the modulator, including microphone

6.5.1 Definition

This characteristic 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.

6.5.2 Method of measurement

An acoustic signal with a frequency of 1 kHz shall be applied to the microphone, and adjusted in level to produce a frequency deviation of ± 3 kHz. The microphone shall be replaced by a sound level meter and the acoustic level measured.

6.5.3 Limits

The sound level applied to the microphone shall be 94 dBA ± 3dB.

6.6 Audio frequency response

6.6.1 Definition

The audio frequency response expresses the ability of the transmitter to operate without excessive degradation of its frequency response as a function of the modulation frequency.

6.6.2 Method of measurement

A modulation signal at a frequency of 1 kHz shall be applied to the transmitter. Its level shall be adjusted so that the frequency deviation is ± 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.

6.6.3 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 and - 3 dB.

6.7 Audio frequency harmonic distortion of the emission

6.7.1 Definition

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

6.7.2 Method of measurement

The RF 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. This test shall be carried out with the output power switch at both maximum and minimum.

6.7.2.1 Normal test conditions

Under normal test conditions (subclause 4.3) the RF signal shall be modulated successively at frequencies of 300 Hz, 500 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.

6.7.2.2 Extreme test conditions

Under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously), the measurements shall be carried out at 1 kHz with a frequency deviation of ± 3 kHz.

6.7.3 Limits

The harmonic distortion shall not exceed 10 %.

6.8 Adjacent channel power

6.8.1 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 passband 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.

6.8.2 Measurement

6.8.2.1 Method of measurement

The adjacent channel power shall be measured with a power measuring receiver which conforms to subclause 6.8.2.2 (referred to in subclauses 6.8.2.1 and 6.8.2.2 as the "receiver").

a) The transmitter shall be operated at the carrier power determined in subclause 6.2 under normal test conditions. 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 Ω and the level at the "receiver" input is appropriate;

b) with the transmitter unmodulated **2)** , 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 ± 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 to 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.

6.8.2.2 Power measuring receiver specification

The power measuring receiver consists of a mixer, an IF filter, and 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 below.

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2) 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.

6.8.2.2.1 IF filter

The IF filter shall be within the limits of the following selectivity characteristics.

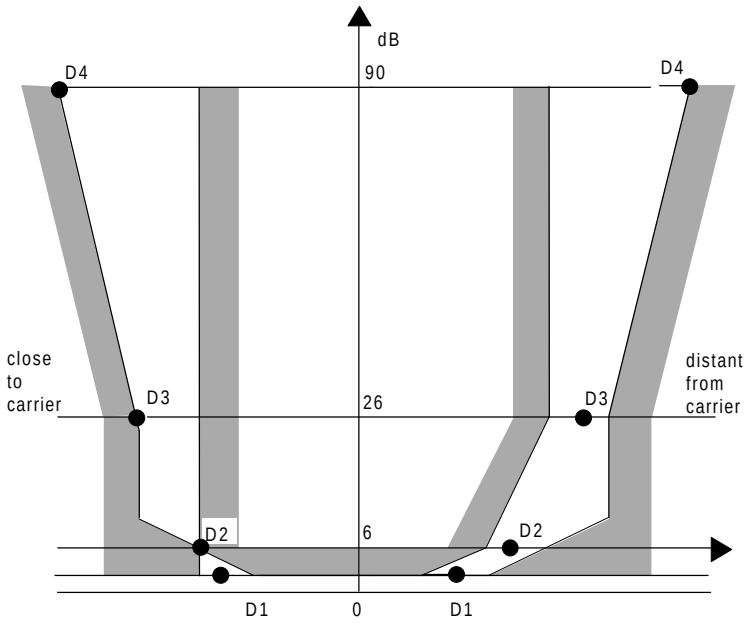

Figure 2

The selectivity characteristic shall keep the following frequency separations from the nominal centre frequency of the adjacent channel:

Table 2: 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:

Table 3: Attenuation points close to carrier

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

Table 4: 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 must be equal to or greater than 90 dB.

6.8.2.2.2 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.

6.8.2.2.3 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.

6.8.2.2.4 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 unmodulated transmitter, whose self-noise has a negligible influence on the measurement result, yields a measured value of < - 90 dB.

6.8.3 Limits

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 µW.

6.9 Conducted spurious emissions conveyed to the antenna

6.9.1 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.

6.9.2 Method of measurement

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna (subclause 5.4).

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.

6.9.3 Limit

The power of any conducted spurious emission on any discrete frequency shall not exceed 0,25 µW.

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

6.10.1 Definitions

Cabinet radiation consists of emissions at frequencies, other than those of the carrier and the sideband components resulting from the wanted modulation process, which are 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.

6.10.2 Method of measurement

On a suitable test site, the transmitter shall be operated at the carrier power as specified under subclause 6.2, delivered to an artificial antenna without modulation.

Radiation of any spurious components shall be detected by a test antenna and receiver, 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 component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement.

The measurements shall be repeated with the test antenna in the orthogonal polarisation plane.

The measurements shall be repeated with the transmitter in stand-by.

6.10.3 Limits

Transmitter in stand-by: not exceeding 2 nW;

Transmitter in operation: not exceeding 0,25 µW.

6.11 Residual modulation of the transmitter

6.11.1 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.

6.11.2 Method of measurement

The normal test modulation defined in subclause 5.3 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 ms.

Precautions shall be taken to avoid the effects of emphasising 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.

6.11.3 Limit

The residual modulation shall not exceed - 40 dB.

6.12 Transient frequency behaviour of the transmitter

6.12.1 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.

t_{on}: according to the method of measurement described in subclause 6.12.2 the switch-on instant t_{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_{on} and finishing according to the table;

t_2: period of time starting at the end of t_1 and finishing according to the table;

t_{off}: switch-off instant defined by the condition when the nominal power falls below 0,1 % of the nominal power;

t_3: period of time that finishing at toff and starting according to the table.

Table 5

t_1 (ms)	5,0
t_2 (ms)	20,0
t_3 (ms)	5,0

NOTE: 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.

6.12.2 Method of measurement

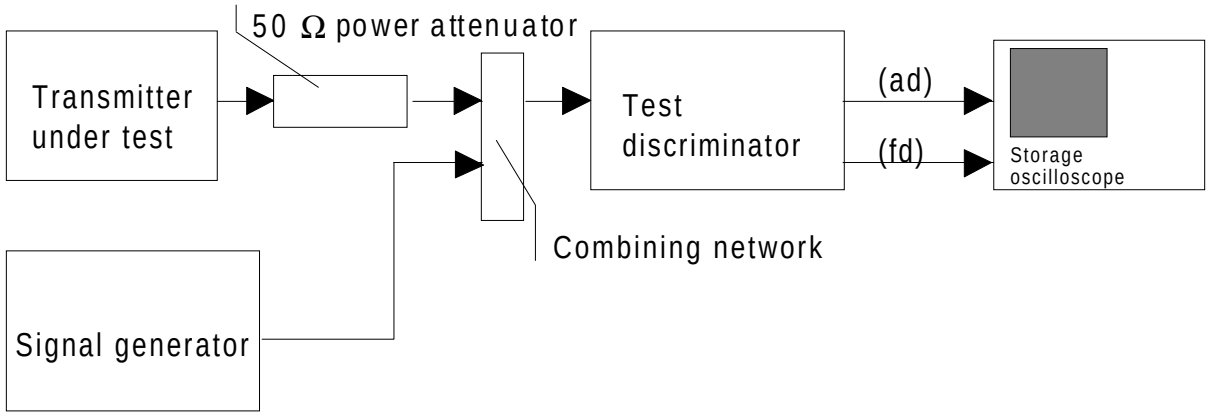

Figure 3: Measurement arrangement

Two signals shall be connected to the test discriminator via a combining network (subclause 5.1).

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 ± 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) and the frequency difference (fd) 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/div and set so that the triggering occurs at 1 div 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 amplitude difference (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_{on}.

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

During the period of time t_1 and t_2 the frequency difference shall not exceed the values given in subclause 6.12.1.

The frequency difference, after the end of t_2, shall be within the limit of the frequency error, subclause 6.1.

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 amplitude difference (ad) input at a high input level, decaying and set so that the triggering occurs at 1 div 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_{off}.

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

During the period of time t_3 the frequency difference shall not exceed the values given in subclause 6.12.1.

Before the start of t_3 the frequency difference shall be within the limit of the frequency error, subclause 6.1.

The result shall be recorded as frequency difference versus time.

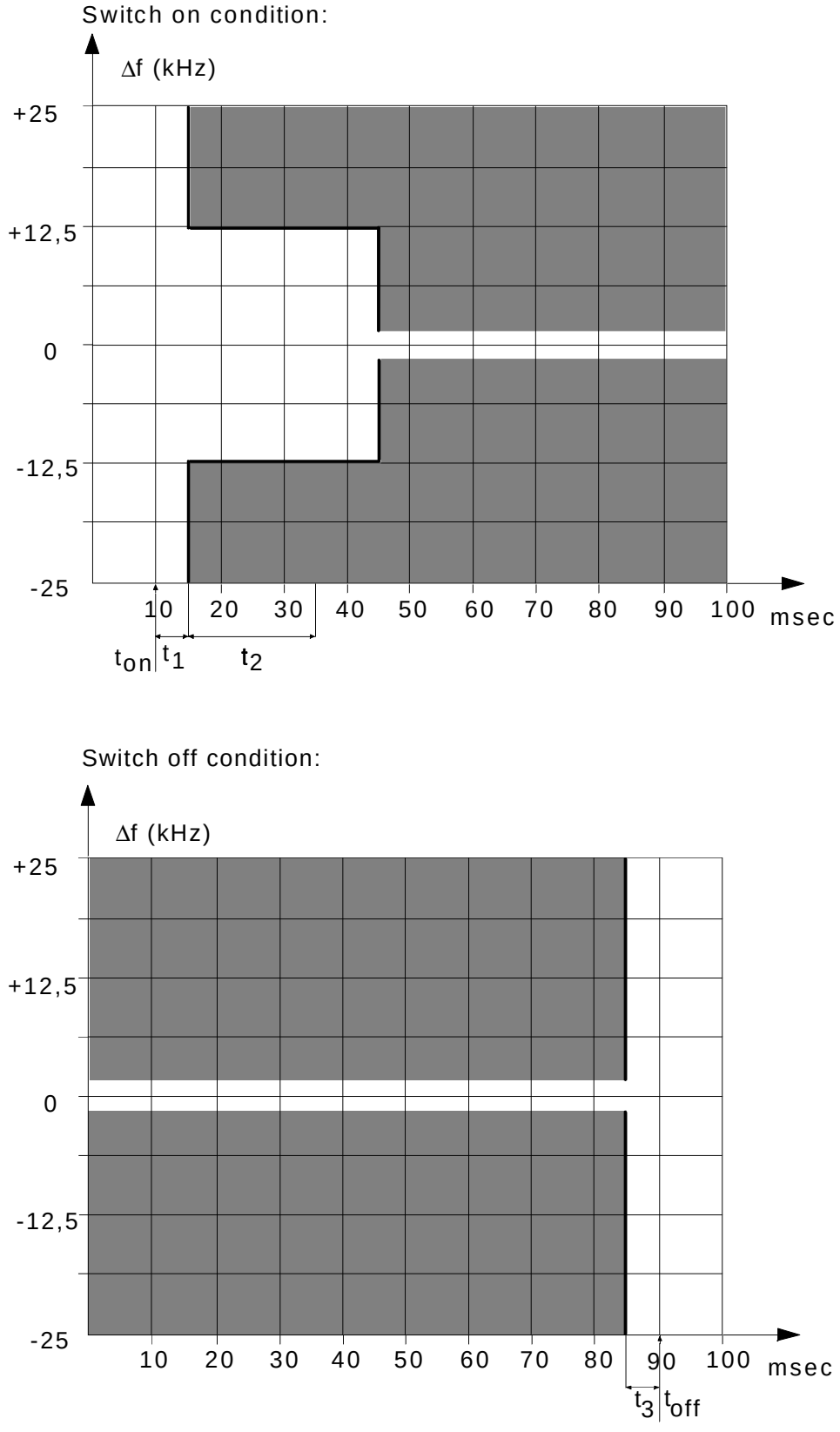

Figure 4: Storage oscilloscope view t_1, t_2 and t_3

7 Receiver

7.1 Harmonic distortion and rated audio frequency output power

7.1.1 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 this ETS are met.

7.1.2 Methods of measurement

Test signals at levels of + 60 dµmV (emf) and + 100 dBµV (emf), at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation (subclause 5.3) shall be applied in succession to the receiver input under the conditions specified in subclause 5.1.

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 (subclause 7.1.1). The value of this load shall be stated by the manufacturer.

Under normal test conditions (subclause 4.3) the test signal shall be modulated successively at 300 Hz, 500 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 all the frequencies specified above.

Under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously), the tests shall be made at the receiver's nominal frequency and at the nominal frequency ± 1,5 kHz. For these tests, the modulation shall be 1 kHz and the frequency deviation shall be ± 3 kHz.

7.1.3 Limits

The rated audio frequency output power shall be at least:

- 2 W in a loudspeaker;

- 1 mW in the handset earphone.

The harmonic distortion shall not exceed 10 %.

7.2 Audio frequency response

7.2.1 Definition

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

7.2.2 Method of measurement

A test signal of + 60 dBµV (emf), at a carrier frequency equal to the nominal frequency of the receiver, shall be applied to the receiver input under the conditions specified in subclause 5.1.

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 (subclause 7.1) when the normal test modulation is applied in accordance with subclause 5.3. This setting shall remain unchanged during the test.

The frequency deviation shall then be reduced to ± 1 kHz.

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 the same frequency as the nominal frequency of the receiver ± 1,5 kHz.

7.2.3 Limits

The receiver 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.

7.3 Maximum usable sensitivity

7.3.1 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 (subclause 5.3), will produce:

- in all cases, an audio frequency output power equal to 50 % of the rated output power (subclause 7.1); and

- a SINAD ratio of 20 dB, measured at the receiver output through a psophometric telephone filtering network such as described in CCITT Recommendation P.53 [5].

7.3.2 Method of measurement

A test signal at a carrier frequency equal to the nominal frequency of the receiver, modulated by the normal test modulation (subclause 5.3) shall be applied to the receiver input. An audio frequency load and a measuring instrument for measuring the SINAD ratio (through a psophometric network as specified in subclause 7.3.1) 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, using the psophometric network and with the receiver's audio frequency power control adjusted to produce 50 % of the rated output power. Under these conditions, the level of the test signal at the input is the value of the maximum usable sensitivity.

The measurements shall be made under normal test conditions (subclause 4.3) and under extreme test conditions (subclauses 4.4.1 and 4.4.2 applied simultaneously).

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

7.3.3 Limits

The maximum usable sensitivity shall not exceed + 6 dBµV (emf) under normal test conditions and + 12 dBµV (emf) under extreme test conditions.

7.4 Co-channel rejection

7.4.1 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.

7.4.2 Method of measurement

The two input signals shall be connected to the receiver via a combining network (subclause 5.1). The wanted signal shall have normal test modulation (subclause 5.3). The unwanted signal shall be modulated by 400 Hz with a deviation of ± 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 up to ± 3 kHz.

The wanted input signal level shall be set to the value corresponding to the maximum usable sensitivity as measured in subclause 7.3. 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.

7.4.3 Limit

The co-channel rejection ratio, at any frequency of the unwanted signal within the specified range, shall be between - 8 dB and 0 dB.

7.5 Adjacent channel selectivity

7.5.1 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.

7.5.2 Method of measurement

The two input signals shall be applied to the receiver input via a combining network (subclause 5.1). The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (subclause 5.3). The unwanted signal shall be modulated by 400 Hz with a deviation of ± 3 kHz, and shall be at the frequency of the channel immediately above that of the wanted signal.

The wanted input signal level shall be set to the value corresponding to the maximum usable sensitivity as measured in subclause 7.3. The amplitude of the unwanted input signal shall then be adjusted until the SINAD ratio at the receiver output, psophometrically weighted, 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 (subclauses 4.4.1 and 4.4.2 applied simultaneously) with the wanted signal set to the value corresponding to the maximum usable sensitivity under these conditions.

7.5.3 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.

7.6 Spurious response rejection

7.6.1 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.

7.6.2 Method of measurement

Two input signals shall be applied to the receiver input via a combining network (subclause 5.1). The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (subclause 5.3).

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

The wanted input signal level shall be set to the value corresponding to the maximum usable sensitivity as measured in subclause 7.3. The amplitude of the unwanted input signal shall be adjusted to an emf of + 86 dBµV. The frequency shall then be swept over the frequency range from 100 kHz to 2 000 MHz.

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.

7.6.3 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.

7.7 Intermodulation response

7.7.1 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.

7.7.2 Method of measurement

Three signal generators, A, B and C shall be connected to the receiver via a combining network (subclause 5.1). The wanted signal, represented by signal generator A shall be at the nominal frequency of the receiver and shall have normal test modulation (subclause 5.3). The unwanted signal from signal generator B shall be unmodulated 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 ± 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 maximum usable sensitivity as measured in subclause 7.3. The amplitude of the two unwanted signals shall be maintained equal and shall be adjusted until the SINAD ratio at the receiver output, psophometrically weighted, 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.

7.7.3 Limit

The intermodulation response ratio shall be greater than 68 dB.

7.8 Blocking or desensitisation

7.8.1 Definition

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

7.8.2 Method of measurement

Two input signals shall be applied to the receiver via a combining network (subclause 5.1). The modulated wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (subclause 5.3). Initially the unwanted signal shall be switched off and the wanted signal set to the value corresponding to the maximum usable sensitivity.

The output power of the wanted signal shall be adjusted, where possible, to 50 % of the rated output power and in the case of stepped volume controls, to the first step that provides an output power of at least 50 % of the rated output power. The unwanted signal shall be unmodulated and the frequency shall be swept between + 1 MHz and + 10 MHz, and also between - 1 MHz and - 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 so adjusted that the unwanted signal causes:

a) a reduction of 3 dB in the output level of the wanted signal; or

b) a reduction to 14 dB of the SINAD ratio at the receiver output using a psophometric telephone filtering network such as described in CCITT Recommendation P.53 [5] whichever occurs first. This level shall be noted.

7.8.3 Limit

The blocking level for any frequency within the specified ranges, shall be not less than 90 dBµV (emf), except at frequencies on which spurious responses are found (subclause 7.6).

7.9 Spurious emissions

7.9.1 Definition

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

The level of spurious emissions shall be measured by:

a) their power level in a transmission line or antenna; and

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

NOTE: b) is also known as "cabinet radiation".

7.9.2 Method of measuring the power level

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

7.9.3 Method of measuring the effective radiated power

On a suitable test site the receiver shall be operated from a power source via a radio frequency filter to avoid radiation from the power leads.

Radiation of any spurious components shall be detected by a test antenna and receiver over the frequency range 30 MHz to 2 GHz.

At each frequency at which a component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement.

The measurements shall be repeated with the test antenna in the orthogonal polarisation plane.

7.9.4 Limit

The power of any spurious radiation shall not exceed the values given below.

a) conducted: between 9 kHz and 2 GHz - 2 nW;

b) radiated: between 30 MHz and 2 GHz - 2 nW.

7.10 Amplitude response of the receiver limiter

7.10.1 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.

7.10.2 Method of measurement

A test signal at the nominal frequency of the receiver and modulated by the normal test modulation (subclause 5.3) at a level of + 6 dB relative to 1 mV (emf) 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 output power (subclause 7.1). The level of the input signal shall be increased to + 100 dBµV and the audio frequency output level shall be measured again.

7.10.3 Limit

When the radio frequency input level is varied as specified, the variation between the maximum and minimum value of the audio frequency output level shall not exceed 3 dB.

7.11 Receiver noise and hum level

7.11.1 Definition

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

7.11.2 Method of measurement

A test signal with a level of + 30 dBµV (emf) at a carrier frequency equal to the nominal frequency of the receiver, and modulated by the normal test modulation specified in subclause 5.3, 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 output power level conforming to subclause 7.1.

The output signal shall be measured by an rms voltmeter. The modulation shall then be switched off and the audio frequency output level measured again.

7.11.3 Limit

The receiver noise and hum level shall not exceed - 40 dB.

7.12 Squelch operation

7.12.1 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.

7.12.2 Method of measurement

a) With the squelch facility switched off, a test signal of + 30 dBµV, at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation specified in subclause 5.3, shall be applied to the input terminals of the receiver. An audio frequency load and a psophometric filtering network (subclause 7.3.1) 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 subclause 7.1.

   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 dBµV (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 dBµV (emf), and the receiver shall be adjusted to give 50 % of the rated audio output power. The squelch facility shall then be switched on 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.

7.12.3 Limits

Under the conditions specified in a) subclause 7.12.2, the audio frequency output power shall not exceed - 40 dB relative to the rated output power.

Under the conditions specified in b) subclause 7.12.2, the input level shall not exceed + 6 dBµV (emf) and the SINAD ratio shall be at least 20 dB.

Under the conditions specified in c) subclause 7.12.2, the input signal shall not exceed + 6 dBµV (emf) when the control is set at maximum.

7.13 Squelch hysteresis

7.13.1 Definition

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

7.13.2 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.

7.13.3 Limit

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

7.14 Multiple watch characteristic

7.14.1 Definition

The scanning period is the time between the start of two successive samples of the priority channel in the absence of a signal on that channel.

The dwell time on the priority channel is the time between the start and finish of any sample of the priority channel in the absence of a signal on that channel.

The dwell time on the additional channel is the time between the start and finish of any sample of the additional channel.

7.14.2 Method of measurement

The equipment shall be adjusted to scan the priority channel and one additional channel.

The squelch shall be operational and so adjusted that the receiver just mutes on both the channels. A test signal at the carrier frequency equal to the nominal frequency of the additional channel of the receiver, modulated by the normal test modulation (subclause 5.3) shall be connected to the receiver via a combining network (subclause 5.1). A second test signal with a frequency equal to the nominal frequency of the priority channel having no modulation shall be connected to the receiver via the other input of the combining network. The level of the two test signals shall be + 12 dBµV (emf) at the receiver input. A storage oscilloscope shall be connected to the audio output. Initially the output of the test signal on the priority channel shall be switched off. The scanning process is started and the output observed on the oscilloscope. The gap between and the duration of the audio bursts shall be measured. Now the test signal on the priority channel shall be switched on and the scanning shall stop on the priority channel after the last burst and within the dwell time on the priority channel. The measurement shall be carried out where the additional channel is a simplex channel and repeated where it is a duplex channel.

The measurements shall be made under normal and under extreme test conditions.

7.14.3 Limits

The scanning period shall not exceed 2 s.

The dwell time on the priority channel shall not exceed 150 ms.

The dwell time on the additional channel shall be between 850 ms and 2 s as indicated by the time of the gap between two output bursts.

8 Duplex operation

If the equipment is designed for duplex operation, when submitted for conformance testing it shall be fitted with a duplex filter and the following additional measurements shall be carried out to ensure satisfactory duplex operation.

8.1 Receiver desensitisation with simultaneous transmission and reception

8.1.1 Definition

The desensitisation is the degradation of the sensitivity of the receiver resulting from the transfer of power from the transmitter to the receiver due to coupling effects.

It is expressed as the difference in dB of the maximum usable sensitivity levels with simultaneous transmission and without.

8.1.2 Method of measurement

The antenna terminal of the equipment comprising the receiver, transmitter and duplex filter shall be connected through a coupling device to the artificial antenna specified in subclause 5.4.

A signal generator with normal test modulation (subclause 5.3) shall be connected to the coupling device so that it does not affect the impedance matching.

The transmitter shall be brought into operation at the carrier output power as defined in subclause 6.2, modulated by 400 Hz with a deviation of ± 3 kHz.

The receiver sensitivity shall then be measured in accordance with subclause 7.3.

The output level of the signal generator shall be recorded as C in dBµV (emf).

The transmitter shall be switched off and the receiver sensitivity is again measured.

The output level of the signal generator shall be recorded as D in dBµV (emf).

The desensitisation is the difference between the values of C and D.

8.1.3 Limits

The desensitisation shall not exceed 3 dB. The maximum usable sensitivity under conditions of simultaneous transmission and reception shall not exceed the limits specified in subclause 7.3.3.

8.2 Receiver spurious response rejection

The receiver spurious response rejection shall be measured as specified in subclause 7.6 with the equipment arrangement described in subclause 8.1.2, except that the transmitter shall be unmodulated. The transmitter shall be operated at the carrier output power as defined in subclause 6.2.

The limit given in subclause 7.6.3 applies.

9 Interference

9.1 General

All reasonable and practicable steps should be taken to ensure electromagnetic compatibility between the equipment concerned and other radio communication and navigational equipment carried on board in compliance with the relevant requirements of Chapter IV and Chapter V of the 1974 SOLAS Convention as amended [6].

9.2 Conducted spurious emission into the mains

9.2.1 Conditions of measurement

The interconnection cable between the equipment under test and the artificial mains network shall be screened and not exceed 0,6 m in length. The antenna connection of the equipment under test, if any, shall be terminated with a non-radiating artificial antenna.

9.2.2 Method of measurement

Conducted spurious emissions shall be measured in the frequency range of 9 kHz to 30 MHz as described in CISPR Publication 16 [7], section 1 - measuring receiver -, section 2 subclauses 8.1 to 8.3 - artificial mains network (50 Ω).

9.2.3 Limits

The level of any conducted spurious signal shall not exceed the values given in figure 5.

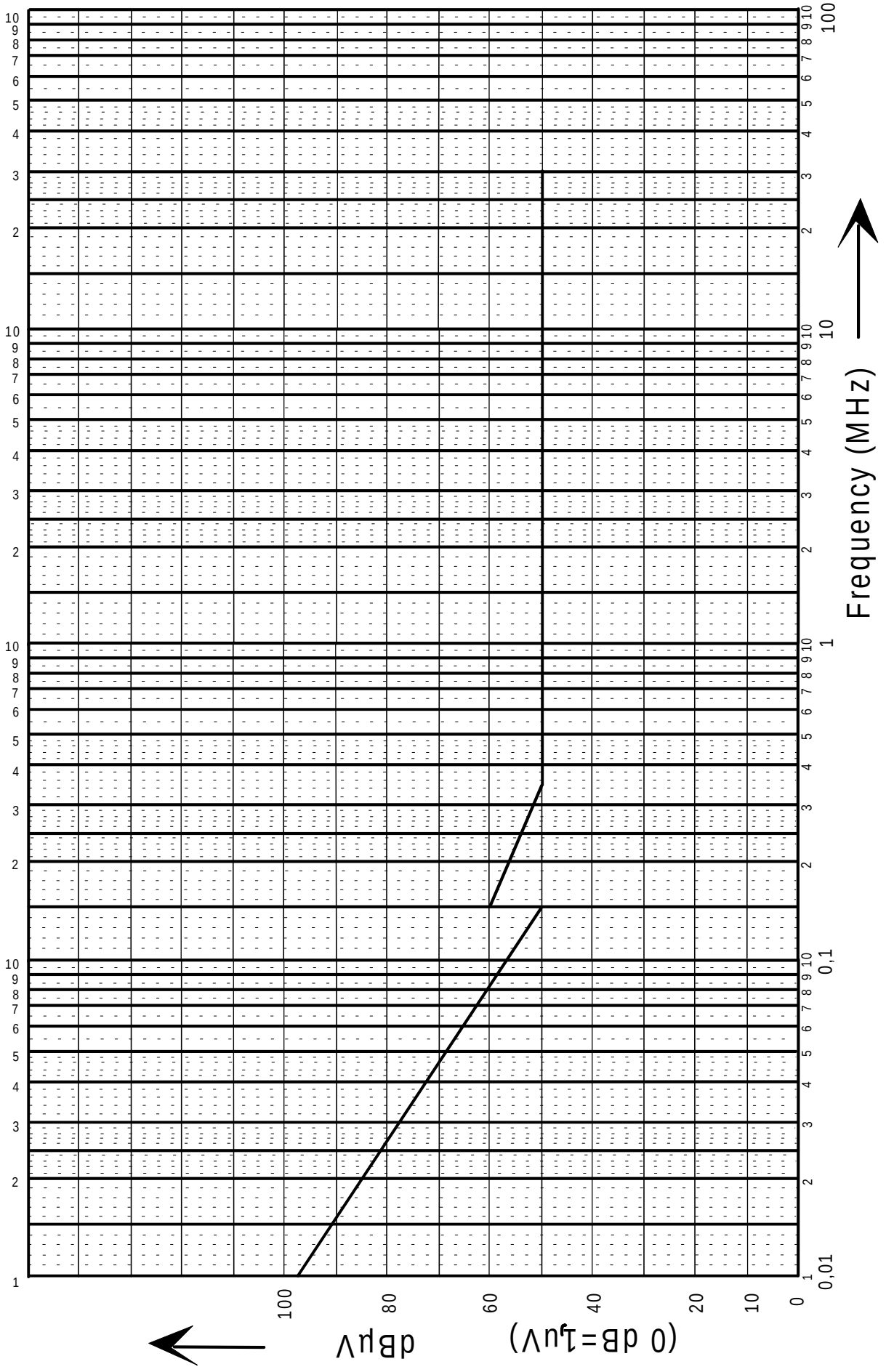

Figure 5: Maximum level of conducted spurious voltage into the mains

History

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