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Candidate Harmonized European Standard (Telecommunications series)

Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF radiotelephone equipment for general communications and associated equipment for Class "D" Digital Selective Calling (DSC); Part 2: Harmonized EN under article 3.2 of the R&TTE Directive

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Contents

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Foreword

This Candidate Harmonized European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI standards Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC [5] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Directive 1999/5/EC [1] of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity ("the R&TTE Directive").

The present document is part 2 of a multi-part deliverable covering the Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF radiotelephone equipment for general communications and associated equipment for Class "D" Digital Selective Calling (DSC), as identified below:

Part 1: "Technical characteristics and methods of measurement";

Part 2: "Harmonized EN under article 3.2 of the R&TTE Directive";

Part 3: "Harmonized EN under article 3.3 (e) of the R&TTE Directive".

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

Introduction

The present document is part of a set of standards designed to fit in a modular structure to cover all radio and telecommunications terminal equipment under the R&TTE Directive [1]. Each standard is a module in the structure. The modular structure is shown in figure 1.

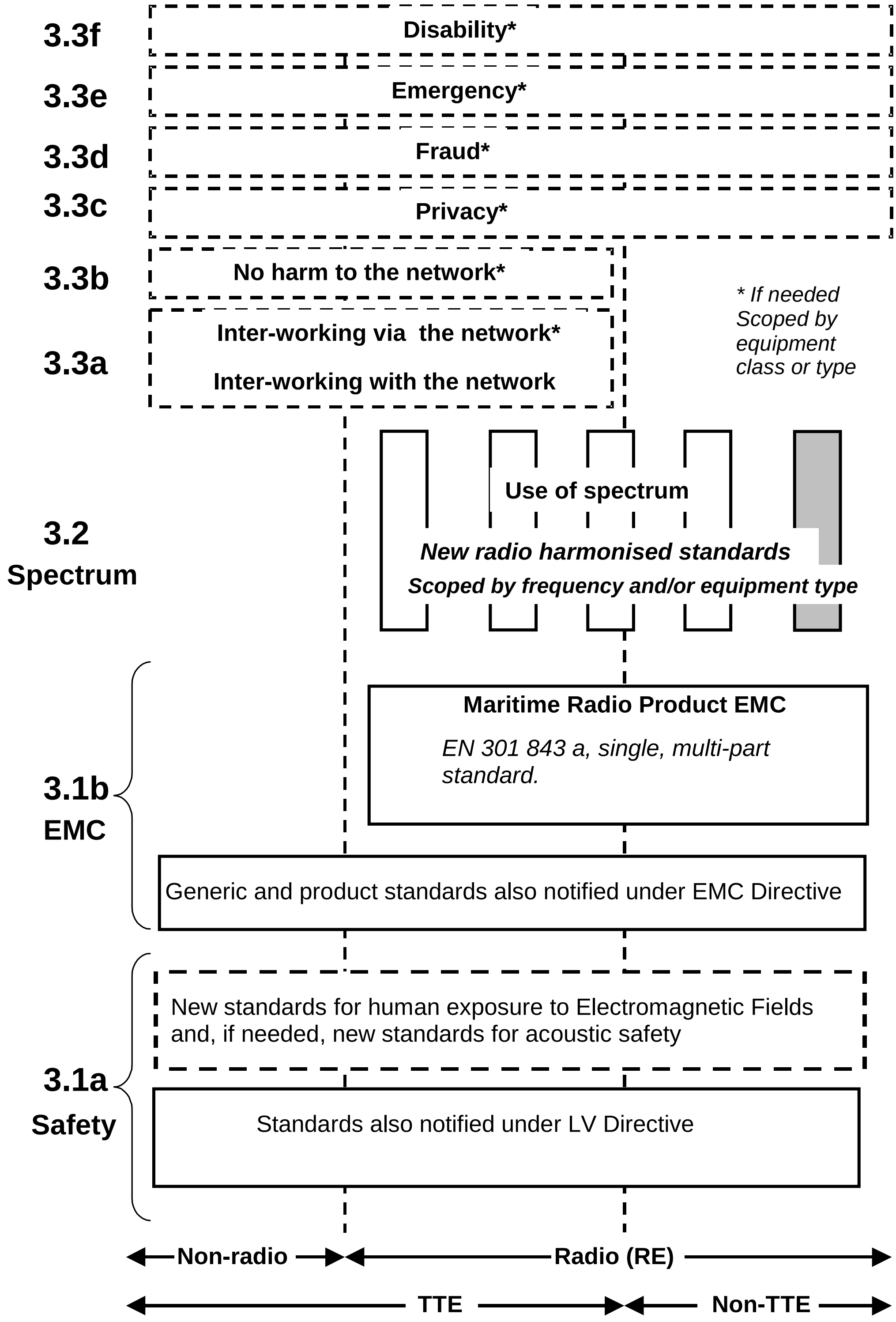


Figure 1: Modular structure for the various standards used under the R&TTE Directive

The left hand edge of the figure 1 shows the different clauses of article 3 of the R&TTE Directive [1].

For article 3.3 various horizontal boxes are shown. Dotted lines indicate that at the time of publication of the present document essential requirements in these areas have to be adopted by the Commission. If such essential requirements are adopted, and as far and as long as they are applicable, they will justify individual standards whose scope is likely to be specified by function or interface type.

The vertical boxes show the standards under article 3.2 for the use of the radio spectrum by radio equipment. The scopes of these standards are specified either by frequency (normally in the case where frequency bands are harmonized) or by radio equipment type.

For article 3.1b the diagram shows EN 301 843, the multi-part product EMC standard for maritime radio, and the existing collection of generic and product standards currently used under the EMC Directive [2].

For article 3.1a the diagram shows the existing safety standards currently used under the LV Directive [3] and new standards covering human exposure to electromagnetic fields. New standards covering acoustic safety may also be required.

The bottom of the figure shows the relationship of the standards to radio equipment and telecommunications terminal equipment. A particular equipment may be radio equipment, telecommunications terminal equipment or both. A radio spectrum standard will apply if it is radio equipment. An article 3.3 standard will apply as well only if the relevant essential requirement under the R&TTE Directive [1] is adopted by the Commission and if the equipment in question is covered by the scope of the corresponding standard. Thus, depending on the nature of the equipment, the essential requirements under the R&TTE Directive [1] may be covered in a set of standards.

The modularity principle has been taken because:

- it minimizes the number of standards needed. Because equipment may, in fact, have multiple interfaces and functions it is not practicable to produce a single standard for each possible combination of functions that may occur in an equipment;
- it provides scope for standards to be added:
  - under article 3.2 when new frequency bands are agreed; or
  - under article 3.3 should the Commission take the necessary decisions without requiring alteration of standards that are already published;
- it clarifies, simplifies and promotes the usage of Harmonized Standards as the relevant means of conformity assessment.

1 Scope

The present document applies to VHF radiotelephone equipment for general communications and associated equipment for class "D" Digital Selective Calling (DSC).

This radio equipment operates within all or any part of the frequency band 156 MHz to 174 MHz allocated to the Maritime Mobile Service and utilizes class of emission G3E, and possibly G2B.

The present document is intended to cover the provisions of Directive 1999/5/EC [1] (R&TTE Directive) article 3.2, which states that "… radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive [1] may apply to equipment within the scope of the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

[1] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

[2] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).

[3] Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

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

[5] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.

[6] ITU-R Recommendation SM.332-4 (1978): "Selectivity of receivers".

[7] ITU-R Recommendation M.493-10 (2000): "Digital selective-calling system for use in the maritime mobile service".

[8] ITU-R Recommendation M.821-1 (1997): "Optional expansion of the digital selective-calling system for use in the maritime mobile service".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the R&TTE Directive [1] and the following apply:

class D: class D equipment is intended to provide minimum facilities for VHF DSC distress, urgency and safety as well as routine calling and reception, not necessarily in full accordance with IMO GMDSS carriage requirements for VHF installations

carrier frequency: frequency to which the transmitter or receiver is tuned

environmental profile: range of environmental conditions under which equipment within the scope of EN 301 025-2 is required to comply with the provisions of EN 301 025-2

frequency deviation: difference between the instantaneous frequency of the modulated RF signal and the carrier frequency

G3E: phase-modulation (frequency modulation with a pre-emphasis of 6 dB/octave) for speech

G2B: phase-modulation with digital information, with a sub-carrier for DSC operation

modulation index: ratio between the frequency deviation and the frequency of the modulation signal

supplier: entity referred to in the R&TTE Directive [1] responsible for the placing on the market of an equipment within the scope of the Directive

3.2 Symbols

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

λ	lambda (wavelength)

3.3 Abbreviations

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

DSC	Digital Selective Calling
e.m.f.	electromotive force
EMC	Electro-Magnetic Compatibility
IMO	International Maritime Organization
LV	Low Voltage
ppm	parts per million
R&TTE	Radio and Telecommunications Terminal Equipment
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
VHF	Very High Frequency

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be determined by the environmental class of the equipment. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the required operational environmental profile.

4.2 Conformance requirements

4.2.1 Transmitter frequency error

4.2.1.1 Definition

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

4.2.1.2 Limits

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

4.2.1.3 Conformance

Conformance tests as defined in clause 5.3.1 shall be carried out.

4.2.2 Transmitter adjacent channel power

4.2.2.1 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.

4.2.2.2 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.

4.2.2.3 Conformance

Conformance tests as defined in clause 5.3.2 shall be carried out.

4.2.3 Transmitter conducted spurious emissions conveyed to the antenna

4.2.3.1 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.

4.2.3.2 Limit

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

4.2.3.3 Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out.

4.2.4 Transmitter cabinet radiation and conducted spurious emissions other than those conveyed to the antenna

4.2.4.1 Definitions

Cabinet radiation consists of emissions at frequency, 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.

4.2.4.2 Limits

When the transmitter is in stand-by the cabinet radiation and spurious emissions shall not exceed 2 nW.

When the transmitter is in operation the cabinet radiation and spurious emissions shall not exceed 0,25 µW.

4.2.4.3 Conformance

Conformance tests as defined in clause 5.3.4 shall be carried out.

4.2.5 Transient frequency behaviour of the transmitter

4.2.5.1 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 clause 5.3.5 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 table 1;
- t_2: period of time starting at the end of t_1 and finishing according to table 1;
- 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 t_{off} and starting according to table 1.

Table 1: Time periods

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

4.2.5.2 Limits

During the periods of time t_1 and t_3 the frequency difference shall not exceed ±25 kHz.

The frequency difference after the end of t_2 shall be within the limit of the frequency error given in clause 4.2.1.

During the period of time t_2 the frequency difference shall not exceed ±12,5 kHz.

Before the start of t_3 the frequency difference shall be within the limit of the frequency error given in clause 4.2.1.

4.2.5.3 Conformance

Conformance tests as defined in clause 5.3.5 shall be carried out.

4.2.6 Transmitter carrier power

4.2.6.1 Definition

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.

4.2.6.2 Limit

4.2.6.2.1 Normal test conditions

With the output power switch set at maximum and the push-to-talk switch timer activated, the carrier power shall remain between 6 W and 25 W and be within ±1,5 dB of the rated output power under normal test conditions. The output power shall never however exceed 25 W.

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

The maximum continuous transmission time shall not exceed 6 min.

4.2.6.2.2 Extreme test conditions

With the output power switch set at maximum and the push-to-talk switch timer activated, 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. The output power shall never however exceed 25 W.

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

The maximum continuous transmission time shall not exceed 6 min.

4.2.6.3 Conformance

Conformance tests as defined in clause 5.3.6 shall be carried out.

4.2.7 Transmitter frequency deviation

4.2.7.1 Definition

For the purposes of the present document, the frequency deviation is the difference between the instantaneous frequency of the modulated radio frequency signal and the carrier frequency.

4.2.7.2 Limits

4.2.7.2.1 Maximum permissible frequency deviation

The maximum frequency deviation shall be ±5 kHz.

4.2.7.2.2 Reduction of frequency deviation at modulation frequencies above 3 kHz

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 2.

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 2.

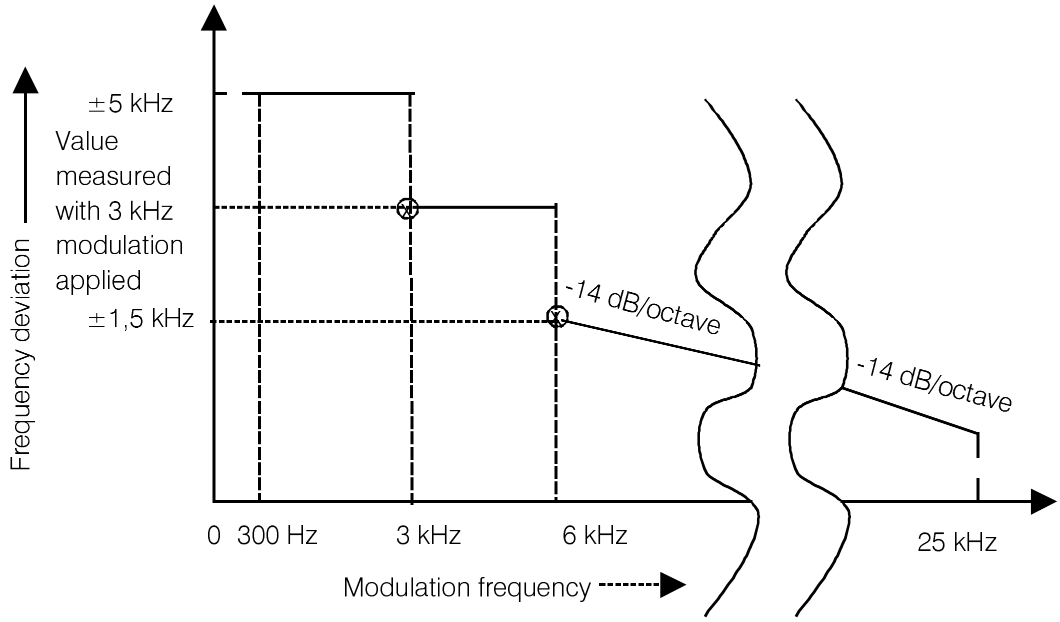


Figure 2: Frequency deviation limits

4.2.7.3 Conformance

Conformance tests as defined in clause 5.3.7 shall be carried out.

4.2.8 DSC frequency error (demodulated DSC signal)

4.2.8.1 Definition

The frequency error for the B- and the Y-state is the difference between the measured frequency from the demodulator and the nominal values.

4.2.8.2 Limit

The measured frequency from the demodulator at any time for the B-state shall be within 2 100 Hz ± 10 Hz and for the Y-state within 1 300 Hz ± 10 Hz.

4.2.8.3 Conformance

Conformance tests as defined in clause 5.3.8 shall be carried out.

4.2.9 DSC modulation index

4.2.9.1 Definition

This test measures the modulation index in the B and Y states.

4.2.9.2 Limit

The modulation index shall be 2,0 ± 10 %.

4.2.9.3 Conformance

Conformance tests as defined in clause 5.3.9 shall be carried out.

4.2.10 DSC modulation rate

4.2.10.1 Definition

The modulation rate is the bit stream speed measured in bit/s.

4.2.10.2 Limit

The frequency shall be 600 Hz ± 30 ppm corresponding to a modulation rate of 1 200 baud.

4.2.10.3 Conformance

Conformance tests as defined in clause 5.3.10 shall be carried out.

4.2.11 Free channel transmission on DSC channel 70

4.2.11.1 Definition

Free channel transmission on DSC channel 70 is defined as the facility to prevent transmission of DSC calls if channel 70 is busy, except in case of distress calls.

4.2.11.2 Requirement

If the format specifier is distress in the transmitted DSC call, the call shall be transmitted even in the presence of other DSC signals.

Otherwise the call shall not be transmitted in the presence of other DSC signals.

4.2.11.3 Conformance

Conformance tests as defined in clause 5.3.11 shall be carried out.

4.2.12 DSC receiver adjacent channel selectivity

4.2.12.1 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.

4.2.12.2 Limits

The bit error ratio shall be equal to or less than 10^{-2}.

4.2.12.3 Conformance

Conformance tests as defined in clause 5.3.12 shall be carried out.

4.2.13 DSC receiver intermodulation response

4.2.13.1 Definition

The intermodulation response is a measure of the capability of the DSC 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.

4.2.13.2 Limit

The bit error ratio shall be equal to or less than 10^{-2}.

4.2.13.3 Conformance

Conformance tests as defined in clause 5.3.13 shall be carried out.

4.2.14 Receiver spurious emissions at the antenna

4.2.14.1 Definition

Spurious emissions from either the radio or DSC receiver are components at any frequency, present at the receiver input port.

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

4.2.14.2 Limit

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

4.2.14.3 Conformance

Conformance tests as defined in clause 5.3.14 shall be carried out.

4.2.15 Receiver cabinet radiated spurious emissions

4.2.15.1 Definition

Radiated spurious emissions from the receiver are components at any frequency radiated by the equipment cabinet and the structure. This test is performed for both the telephony receiver and the DSC receiver.

4.2.15.2 Limit

The power of any spurious radiation shall not exceed 2 nW at any frequency in the range between 30 MHz and 2 GHz.

4.2.15.3 Conformance

Conformance tests as defined in clause 5.3.15 shall be carried out.

4.2.16 DSC receiver maximum usable sensitivity

4.2.16.1 Definition

The maximum usable sensitivity of the receiver is the minimum level of the signal (e.m.f.) at the nominal frequency of the receiver which when applied to the receiver input with a test modulation will produce a bit error ratio of 10^{-2}.

4.2.16.2 Limits

The bit error ratio shall be equal to or less than 10^{-2}.

4.2.16.3 Conformance

Conformance tests as defined in clause 5.3.16 shall be carried out.

4.2.17 DSC receiver co-channel rejection

4.2.17.1 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.

4.2.17.2 Limits

The bit error ratio shall be equal to or less than 10^{-2}.

4.2.17.3 Conformance

Conformance tests as defined in clause 5.3.17 shall be carried out.

4.2.18 DSC receiver spurious response and blocking immunity

4.2.18.1 Definition

The spurious response and blocking immunity 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 with frequencies outside the pass band of the receiver.

4.2.18.2 Limits

The bit error ratio shall be equal to or less than 10^{-2}.

4.2.18.3 Conformance

Conformance tests as defined in clause 5.3.18 shall be carried out.

5 Testing for compliance with technical requirements

5.1 Test conditions, power supply and ambient temperatures

5.1.1 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 electromotive force (e.m.f.) at the terminals to be connected to the receiver.

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

5.1.2 Squelch

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

5.1.3 Transmission time limitation

Unless otherwise specified, the transmitter push-to-talk timer shall be deactivated for test purposes.

5.1.4 Normal test modulation

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

For DSC conformance testing and maintenance purposes, the equipment shall have facilities not accessible to the operator to generate a continuous B or Y signal and dot pattern.

Additionally for conformance testing, the VHF equipment shall have facilities not accessible to the operator for generating an unmodulated carrier.

5.1.5 Artificial antenna

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

5.1.6 Arrangements for test signals applied to the transmitter input

For the purposes of the present document, 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.

5.1.7 Test channels

Conformance tests shall be made on channel 16 for voice and channel 70 for DSC tests, unless otherwise stated.

5.1.8 Generation and examination of the digital selective call signal

During the conformance tests the DSC signals generated by the equipment shall be examined by means of calibrated apparatus for decoding and printing out the information content of the signals.

The decoding part of the equipment may be provided with a printer or an output terminal for connecting an external printer.

The equipment delivered for the purposes of testing shall be provided with a printer or an output terminal for connecting a printer or computer for registration of the decoded call sequences. Details concerning such output signals to an external printer or computer shall be agreed between the manufacturer and the testing laboratory.

The facilities of the equipment for reception and/or decoding of DSC shall be examined by feeding DSC signals from a calibrated DSC generator.

5.1.9 Standard test signals for DSC

The standard test signal for a VHF DSC decoder shall be a phase-modulated signal at VHF channel 70 with modulation index = 2. The modulating signal shall have a nominal frequency of 1 700 Hz and a frequency shift of ±400 Hz with a modulation rate of 1 200 baud.

Standard test signals shall consist of a series of identical call sequences, each of which contain a known number of information symbols (format specifier, address, category, identification etc. of ITU-R Recommendation M.493-10 [7]).

Standard test signals shall be of sufficient length for the measurements to be performed or it shall be possible to repeat them without interruption to make the measurements.

5.1.10 Determination of the symbol error ratio in the output of the receiving part

The information content of the decoded call sequence displayed at the readout device of the receiving part shall be divided into blocks, each of which corresponds to one information symbol in the applied test signal (see clause 5.1.9). The total number of incorrect information symbols relative to the total number of information symbols shall be registered. In the present document, bit error ratio measurements are taken to be equivalent to symbol error ratio measurements.

5.1.11 Test conditions, power sources, and ambient temperatures

5.1.11.1 Normal and extreme test conditions

Conformance tests shall be made under normal test conditions and also, where stated, under extreme test conditions (see clauses 5.1.13.1 and 5.1.13.2 applied simultaneously).

5.1.11.2 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 5.1.13.2 and 5.1.13.2.

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.

5.1.12 Normal test conditions

5.1.12.1 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 %.

Where the relative humidity is less than 20 %, it shall be stated in the test report.

5.1.12.2 Normal power sources

5.1.12.2.1 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.).

5.1.12.2.2 Other power sources

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

5.1.13 Extreme test conditions

Unless otherwise stated the extreme test conditions means that the EUT shall be tested at the upper temperature and at the upper limit of the supply voltage applied simultaneously, and at the lower temperature and the lower limit of the supply voltage applied simultaneously.

5.1.13.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with clause 5.1.14, at a lower temperature of −15°C and an upper temperature of +55°C.

5.1.13.2 Extreme values of test power sources

5.1.13.2.1 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.).

5.1.13.2.2 Other power sources

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

5.1.14 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 in the high power transmit condition for at least 30 min. 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.

5.2 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 value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 2.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028 [4] and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 2 is based on such expansion factors.

Table 2: Maximum values of absolute measurement uncertainties

Parameter	Maximum uncertainty
Radio Frequency (RF)	$\pm 1 \times 10^{-7}$
RF power/level	±0,75 dB
Maximum frequency deviation: - within 300 Hz to 6 kHz of modulation frequency - within 6 kHz to 25 kHz of modulation frequency	 ±5 % ±3 dB
Deviation limitation	±5 %
Adjacent channel power	±5 dB
Conducted spurious emission of transmitter	±4 dB
Conducted emission of receiver	±3 dB
Two-signal measurement	±4 dB
Three-signal measurement	±3 dB
Transmitter transient time	±20 %
Transmitter transient frequency	±250 Hz

5.3 Essential radio test suites

5.3.1 Transmitter frequency error

The carrier frequency shall be measured in the absence of modulation, with the transmitter connected to an artificial antenna (see clause 5.1.5) and tuned to channel 16.

Measurements shall be made under normal test conditions (see clause 5.1.12) and under extreme test conditions (see clauses 5.1.13.1 and 5.1.13.2 applied simultaneously).

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

The results obtained shall be compared to the limits in clause 4.2.1.2 in order to prove compliance with the requirement.

5.3.2 Transmitter adjacent channel power

The adjacent channel power can be measured with a power measuring receiver which conforms to annex B (referred to in clause 4.2.2 and annex B as the "receiver") ITU-R Recommendation SM.332-4 [6]:

a) the transmitter shall be operated with the output power switch at maximum 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, 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.

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.

The results obtained shall be compared to the limits in clause 4.2.2.2 in order to prove compliance with the requirement.

5.3.3 Transmitter conducted spurious emissions conveyed to the antenna

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna (see clause 5.1.5).

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.

The results obtained shall be compared to the limits in clause 4.2.3.2 in order to prove compliance with the requirement.

5.3.4 Transmitter cabinet radiation and conducted spurious emissions other than those conveyed to the antenna

On a test site, selected from annex C, 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, clause 5.1.5.

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 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 annex C;

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.

The results obtained shall be compared to the limits in clause 4.2.4.2 in order to prove compliance with the requirement.

5.3.5 Transient frequency behaviour of the transmitter

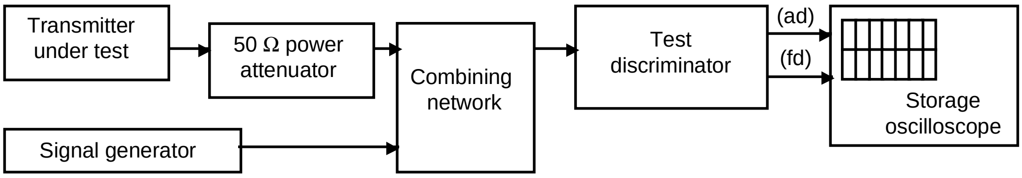


Figure 3: Measurement arrangement

Two signals shall be connected to the test discriminator via a combining network (see clause 5.1.1).

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

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 ±25 kHz.

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

The display shall 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.

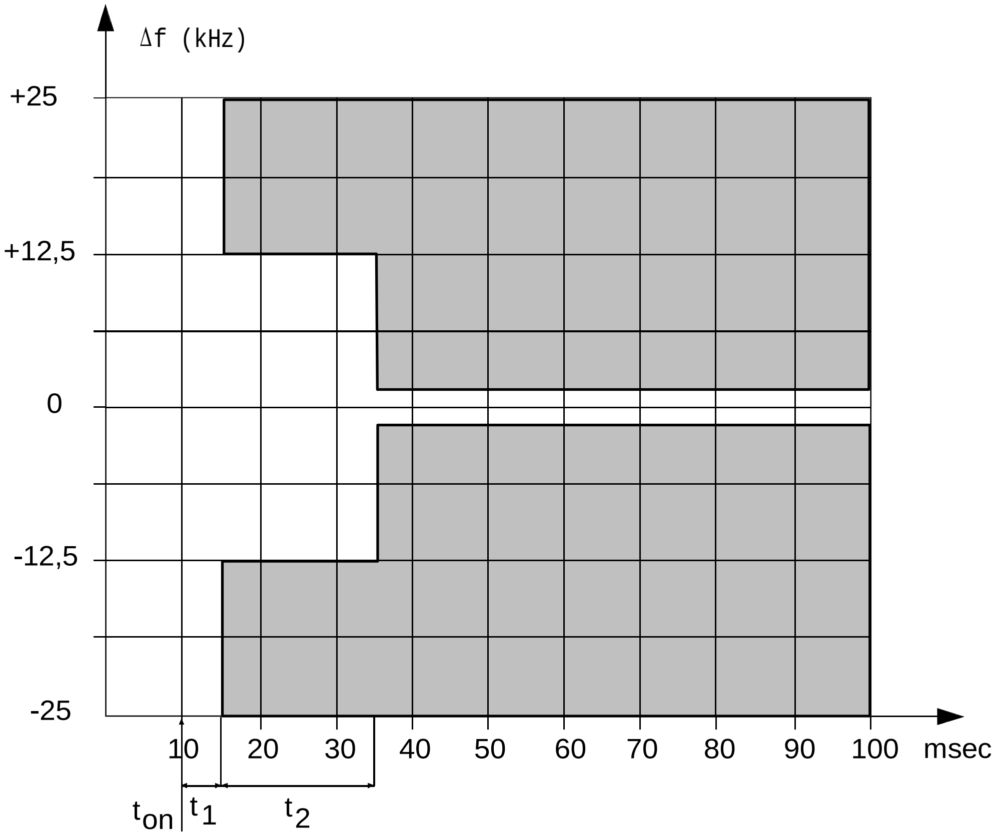
The transmitter shall then be switched on, without modulation, to produce the trigger pulse and a picture on the display.

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 table 1 shall be used to define the appropriate template.

Switch on condition:



Switch off condition:

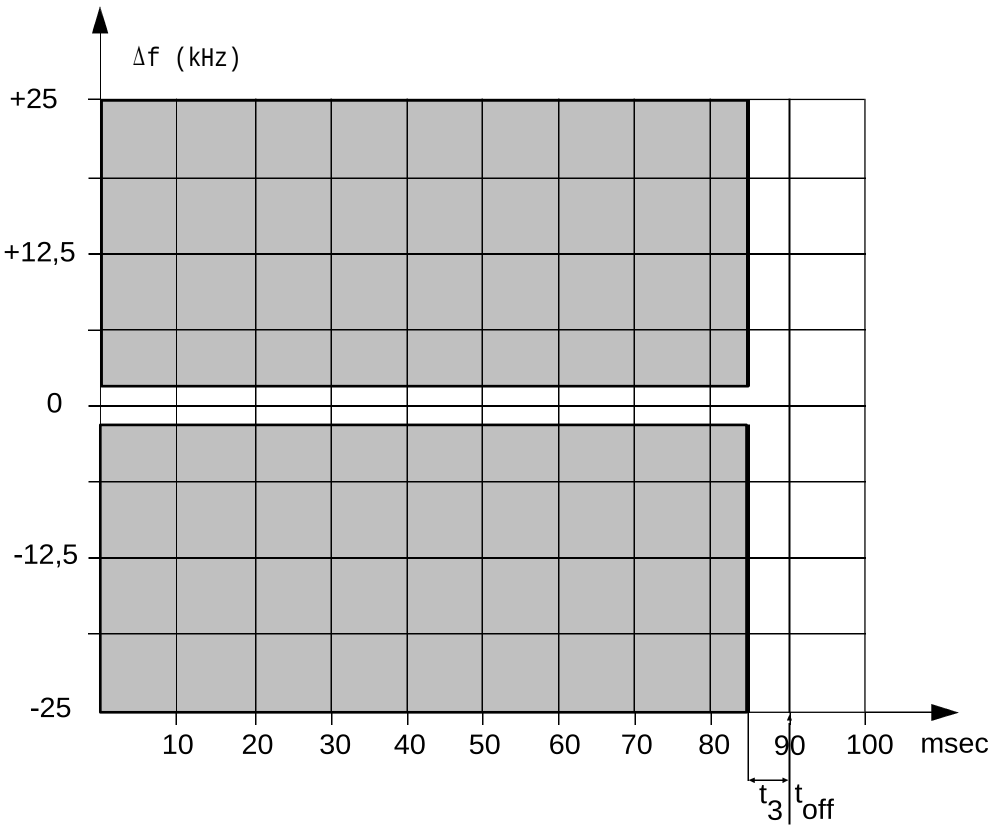


Figure 4: Storage oscilloscope view t_1, t_2 and t_3

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 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_{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.

The results obtained shall be compared to the limits in clause 4.2.5.2 in order to prove compliance with the requirement.

5.3.6 Transmitter carrier power

The transmitter shall be connected to an artificial antenna (see clause 5.1.5) and the power delivered to this artificial antenna shall be measured. The measurements shall be made on channel 16, the highest frequency channel and the lowest frequency channel under normal test conditions (see clause 5.1.12) and channel 16 under extreme test conditions (see clauses 5.1.13.1 and 5.1.13.2 applied simultaneously).

During the test on channel 16, a check should be made that the power output falls to zero after the maximum continuous transmission time, controlled by the push-to-talk switch timer, has elapsed.

The results obtained shall be compared to the limits in clause 4.2.6.2 in order to prove compliance with the requirement.

5.3.7 Transmitter frequency deviation

5.3.7.1 Maximum permissible frequency deviation

The frequency deviation shall be measured at the output with the transmitter connected to an artificial antenna (see clause 5.1.5) and tuned to channel 16, 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 5.1.4). This test shall be carried out with the output power switch set at both maximum and minimum.

5.3.7.2 Reduction of frequency deviation at modulation frequencies above 3 kHz

The transmitter shall operate under normal test conditions (see clause 5.1.12) connected to a load as specified in clause 5.1.5. The transmitter shall be modulated by the normal test modulation (see clause 5.1.4) and tuned to channel 16. 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.

The results obtained shall be compared to the limits in clause 4.2.7.2 in order to prove compliance with the requirement.

5.3.8 DSC frequency error (demodulated DSC signal)

The transmitter shall be connected to the artificial antenna as specified in clause 5.1.5 and a suitable FM demodulator. The transmitter shall be set to channel 70.

The transmitter shall be set to transmit a continuous B- or Y-state.

The measurement shall be performed by measuring the demodulated output, for both the continuous B- and Y-state.

The measurements shall be carried out under normal test conditions (see clause 5.1.12) and extreme test conditions (see clauses 5.1.13.1 and 5.1.13.2 applied simultaneously).

The results obtained shall be compared to the limits in clause 4.2.8.2 in order to prove compliance with the requirement.

5.3.9 DSC modulation index

The transmitter shall be set to transmit continuous B and then Y signals. The frequency deviations shall be measured.

The results obtained shall be compared to the limits in clause 4.2.9.2 in order to prove compliance with the requirement.

5.3.10 DSC modulation rate

The transmitter shall be set to transmit continuous dot pattern.

The RF output terminal of the transmitter, via a suitable attenuator, shall be connected to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low pass filter with a cut-off frequency of 1 kHz and a slope of 12 dB/octave.

The frequency of the output shall be measured.

The results obtained shall be compared to the limits in clause 4.2.10.2 in order to prove compliance with the requirement.

5.3.11 Free channel transmission on DSC channel 70

The output of the transmitter shall be suitably connected to a. calibrated apparatus for decoding and printing out the information content of the call sequences generated by the equipment.

The receiver input is connected to a signal generator. The signal generator is set to the frequency of channel 70 (156.525 MHz) and the RF signal shall be modulated by a standard DSC signal, see clause 5.1.9. The test is performed at an RF level; of +6 dBμV (e.m.f).

If the receiver input and transmitter output are combined in the same port it is necessary to combine the calibrated apparatus for decoding and printing out the information content of the call sequences and the signal generator through a suitable combining network, see clause 5.1.1. It may be necessary to protect the signal generator against the power output from the equipment through an attenuator.

The signal generator output shall be turned on. The transmitter shall be set to transmit DSC calls as specified in annex D.

Then the signal generator output shall be turned off.

The results obtained shall be compared to the limits in clause 4.2.11.2 in order to prove compliance with the requirement.

5.3.12 DSC receiver adjacent channel selectivity

The two input signals shall be connected to the receiver input terminal via a combining network (see clause 5.1.1).

The wanted signal shall be the DSC standard test signal (see clause 5.1.9) containing DSC calls. The level of the wanted signal shall be +3 dBμV under normal test conditions and +9 dBμV under extreme test conditions.

The unwanted signal shall be modulated to 400 Hz with a deviation of ±3 kHz. The unwanted signal shall be tuned to the centre frequency of the upper adjacent channel. The input level of the unwanted signal shall be 73 dBμV under normal test conditions and 63 dBμV under extreme test conditions.

The bit error ratio in the decoder output shall be determined as described in clause 5.1.10.

The measurement shall be repeated with the unwanted signal tuned to the centre frequency of the lower adjacent channel.

The measurement shall be carried out under normal test conditions (see clause 5.1.12) and under extreme test conditions (see clauses 5.1.13.1 and 5.1.13.2 applied simultaneously).

The results obtained shall be compared to the limits in clause 4.2.12.2 in order to prove compliance with the requirement.

5.3.13 DSC receiver intermodulation response

The three input signals shall be connected to the receiver input terminal via a combining network (see clause 5.1.1).

The wanted signal represented by signal generator A shall be at the nominal frequency of the receiver and shall be the DSC standard test signal (see clause 5.1.9) containing DSC calls. The level of the wanted signal shall be +3 dBμV.

The unwanted signals shall be applied, both at the same level. The unwanted signal from signal generator B shall be unmodulated and adjusted to a 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 input level of the unwanted signals shall be 68 dBμV.

The bit error ratio in the decoder output shall be determined as described in clause 5.1.10.

The results obtained shall be compared to the limits in clause 4.2.13.2 in order to prove compliance with the requirement.

5.3.14 Receiver spurious emissions at the antenna

Spurious emissions shall be measured as the power level of any discrete signal at the input terminals of the particular 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.

The results obtained shall be compared to the limits in clause 4.2.14.2 in order to prove compliance with the requirement.

5.3.15 Receiver cabinet radiated spurious emissions

On a test site, selected from annex C, 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 annex C;

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.

The results obtained shall be compared to the limits in clause 4.2.15.2 in order to prove compliance with the requirement.

5.3.16 DSC receiver maximum usable sensitivity

DSC standard test signal (see clause 5.1.9) containing DSC calls shall be applied to the receiver input. The input level shall be 0 dBμV under normal test conditions (see clause 5.1.12) and +6 dBμV under extreme test conditions (see clauses 5.1.13.1 and 5.1.13.2 applied simultaneously).

The measurement shall be repeated under normal test conditions at the nominal carrier frequency ±1,5 kHz.

The bit error ratio in the decoder output shall be determined as described in clause 5.1.10.

The results obtained shall be compared to the limits in clause 4.2.16.2 in order to prove compliance with the requirement.

5.3.17 DSC receiver co-channel rejection

The two input signals shall be connected to the receiver input terminal via a combining network (see clause 5.1.1). The wanted signal shall be the DSC standard test signal (see clause 5.1.9) containing DSC calls. The level of the wanted signal shall be +3 dBμV. 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 shall be repeated for displacements of the unwanted signal of up to ±3 kHz.

The input level of the unwanted signal shall be -5 dBμV.

The bit error ratio in the decoder output shall be determined as described in clause 5.1.10.

The results obtained shall be compared to the limits in clause 4.2.17.2 in order to prove compliance with the requirement.

5.3.18 DSC receiver spurious response and blocking immunity

The two input signals shall be connected to the receiver input terminal via a combining network (see clause 5.1.1).

The wanted signal shall be the DSC standard test signal (see clause 5.1.9) containing DSC calls. The level of the wanted signal shall be +3 dBμV.

For the spurious response test the unwanted signal shall be unmodulated. The frequency shall be varied over the range 9 kHz to 2 GHz with the exception of the channel of the wanted signal and its adjacent channels. The unwanted signal level shall be 73 dBμV. Where spurious response occurs, the bit error ratio shall be determined.

For the blocking test the unwanted signal shall be unmodulated. The frequency shall be varied between -10 MHz and -1 MHz and also between +1 MHz and +10 MHz relative to the nominal frequency of the wanted signal. The unwanted signal shall be at a level of 93 dBμV. Where blocking occurs, the bit error ratio shall be determined.

The bit error ratio in the decoder output shall be determined as described in clause 5.1.10.

The results obtained shall be compared to the limits in clause 4.2.18.2 in order to prove compliance with the requirement.

Annex A (normative): The EN Requirements Table (EN-RT)

The EN Requirements Table (EN-RT) serves a number of purposes, as follows:

- it provides a tabular summary of all the requirements;
- it shows the status of each EN-R, whether it is essential to implement in all circumstances (Mandatory), or whether the requirement is dependent on the supplier having chosen to support a particular optional service or functionality (Optional). In particular it enables the EN-Rs associated with a particular optional service or functionality to be grouped and identified;
- when completed in respect of a particular equipment it provides a means to undertake the static assessment of conformity with the EN.

Table A.1: EN Requirements Table (EN-RT)

EN Reference		EN 301 025-2				Comment
No.	**Reference**	**EN-R (note)**	**Status**			
1	4.2.1	Transmitter frequency error	M			
2	4.2.2	Transmitter adjacent power	M			
3	4.2.3	Transmitter conducted emissions conveyed to the antenna	M			
4	4.2.4	Transmitter cabinet radiation and conducted spurious emissions other than those conveyed to the antenna	M			
5	4.2.5	Transient frequency behaviour of the transmitter	M			
6	4.2.6	Transmitter carrier power	M			
7	4.2.7	Transmitter frequency deviation	M			
8	4.2.8	DSC frequency error (demodulated DSC signal)	M			
9	4.2.9	DSC modulation index	M			
10	4.2.10	DSC modulation rate	M			
11	4.2.11	Free channel transmission on DSC channel 70	M			
12	4.2.12	DSC receiver adjacent channel selectivity	M			
13	4.2.13	DSC receiver intermodulation response	M			
14	4.2.14	Receiver spurious emissions at the antenna	M			
15	4.2.15	Receiver cabinet radiated spurious emissions	M			
16	4.2.16	DSC receiver maximum usable sensitivity	M			
17	4.2.17	DSC receiver co-channel rejection	M			
18	4.2.18	DSC receiver spurious response and blocking immunity	M			
NOTE: These EN-Rs are justified under article 3.2 of the R&TTE Directive.						

Key to columns:

No Table entry number.

Reference Clause reference number of conformance requirement within the present document.

EN-R Title of conformance requirement within the present document.

Status Status of the entry as follows:

M Mandatory, shall be implemented under all circumstances;

O Optional, may be provided, but if provided shall be implemented in accordance with the requirements;

O.n This status is used for mutually exclusive or selectable options among a set. The integer "n" shall refer to a unique group of options within the EN-RT. A footnote to the EN-RT shall explicitly state what the requirement is for each numbered group. For example, "It is mandatory to support at least one of these options", or, "It is mandatory to support exactly one of these options".

Comments To be completed as required.

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

B.1 Power measuring receiver specification

The power measuring receiver consists of a mixer, an IF filter, an oscillator, an amplifier, a variable attenuator and an r.m.s. value indicator. Instead of the variable attenuator with the r.m.s. value indicator it is also possible to use an r.m.s. voltmeter calibrated in dB. The technical characteristics of the power measuring receiver are given below (see also ITU-R Recommendation SM.332-4 [6]).

B.1.1 IF filter

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

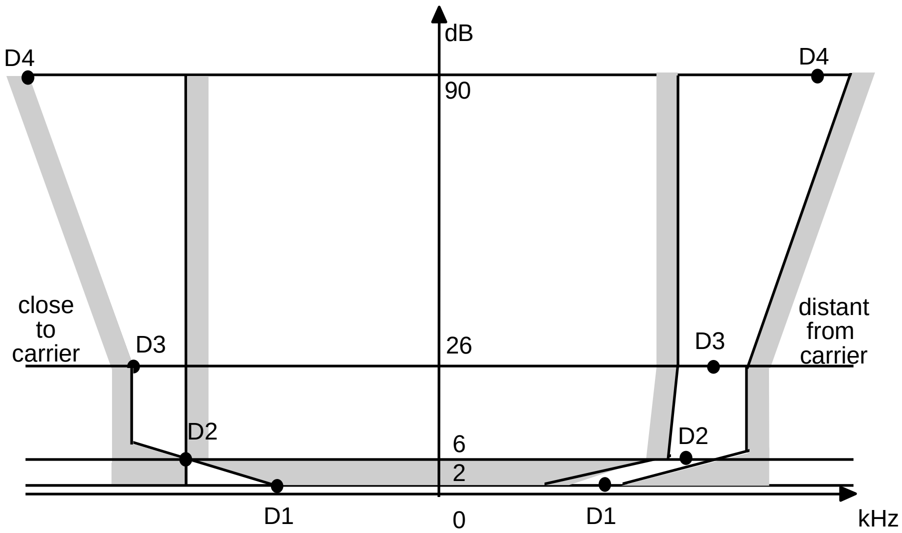


Figure B.1: IF filter characteristics

The selectivity characteristics shall keep the frequency separations shown in table B.1 from the nominal centre frequency of the adjacent channel.

Table B.1: Selectivity characteristic

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

The attenuation points shall not exceed the tolerances shown in tables B.2 and B.3.

Table B.2: Attenuation points close to carrier

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

Table B.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.

B.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.

B.1.3 R.M.S. value indicator

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

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

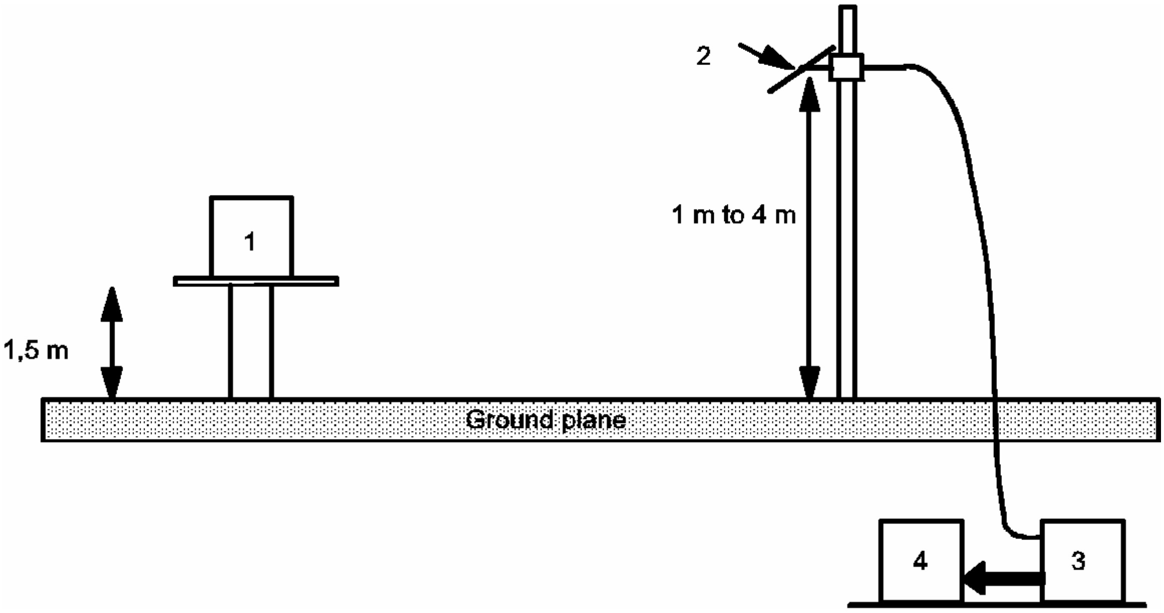
Annex C (normative): Radiated measurements

C.1 Test sites and general arrangements for measurements involving the use of radiated fields

C.1.1 Outdoor test site

The outdoor test site shall be on a reasonably level surface or ground. At one point on the site, a ground plane of at least 5 m diameter shall be provided. In the middle of this ground plane, a non-conducting support, capable of rotation through 360° in the horizontal plane, shall be used to support the test sample at 1,5 m above the ground plane. The test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of λ/2 or 3 m whichever is the greater. The distance actually used shall be recorded with the results of the tests carried out on the site.

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site and ground reflections do not degrade the measurements results.



Key:
1 Equipment under test.
2 Test antenna.
3 High pass filter (necessary for strong fundamental Tx radiation).
4 Spectrum analyser or measuring receiver.

Figure C.1

C.1.2 Test antenna

The test antenna is used to detect the radiation from both the test sample and the substitution antenna, when the site is used for radiation measurements; where necessary, it is used as a transmitting antenna, when the site is used for the measurement of receiver characteristics.

This antenna is mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarization and for the height of its centre above ground to be varied over the range 1 m to 4 m. Preferably a test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20 % of the measuring distance.

For receiver and transmitter radiation measurements, the test antenna is connected to a measuring receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input. For receiver radiated sensitivity measurements the test antenna is connected to a signal generator.

C.1.3 Substitution antenna

When measuring in the frequency range up to 1 GHz the substitution antenna shall be a $\lambda/2$ dipole, resonant at the frequency under consideration, or a shortened dipole, calibrated to the $\lambda/2$ dipole. When measuring in the frequency range above 4 GHz a horn radiator shall be used. For measurements between 1 GHz and 4 GHz either a $\lambda/2$ dipole or a horn radiator may be used. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an external antenna is connected to the cabinet.

The distance between the lower extremity of the dipole and the ground shall be at least 0,3 m.

The substitution antenna shall be connected to a calibrated signal generator when the site is used for spurious radiation measurements and transmitter effective radiated power measurements. The substitution antenna shall be connected to a calibrated measuring receiver when the site is used for the measurement of receiver sensitivity.

The signal generator and the receiver shall be operating at the frequencies under investigation and shall be connected to the antenna through suitable matching and balancing networks.

NOTE: The gain of a horn antenna is generally expressed relative to an isotropic radiator.

C.1.4 Optional additional indoor site

When the frequency of the signals being measured is greater than 80 MHz, use may be made of an indoor site. If this alternative site is used, this shall be recorded in the test report.

The measurement site may be a laboratory room with a minimum area of 6 m by 7 m and at least 2,7 m in height.

Apart from the measuring apparatus and the operator, the room shall be as free as possible from reflecting objects other than the walls, floor and ceiling.

The potential reflections from the wall behind the equipment under test are reduced by placing a barrier of absorbent material in front of it. The corner reflector around the test antenna is used to reduce the effect of reflections from the opposite wall and from the floor and ceiling in the case of horizontally polarized measurements. Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarized measurements. For the lower part of the frequency range (below approximately 175 MHz) no corner reflector or absorbent barrier is needed. For practical reasons, the $\lambda/2$ antenna in figure C.2 may be replaced by an antenna of constant length, provided that this length is between $\lambda/4$ and λ at the frequency of measurement and the sensitivity of the measuring system is sufficient. In the same way the distance of $\lambda/2$ to the apex may be varied.

The test antenna, measuring receiver, substitution antenna and calibrated signal generator are used in a way similar to that of the general method.

To ensure that errors are not caused by the propagation path approaching the point at which phase cancellation between direct and the remaining reflected signals occurs, the substitution antenna shall be moved through a distance of ±0,1 m in the direction of the test antenna as well as in the two directions perpendicular to this first direction.

If these changes of distance cause a signal change of greater than 2 dB, the test sample should be re-sited until a change of less than 2 dB is obtained.

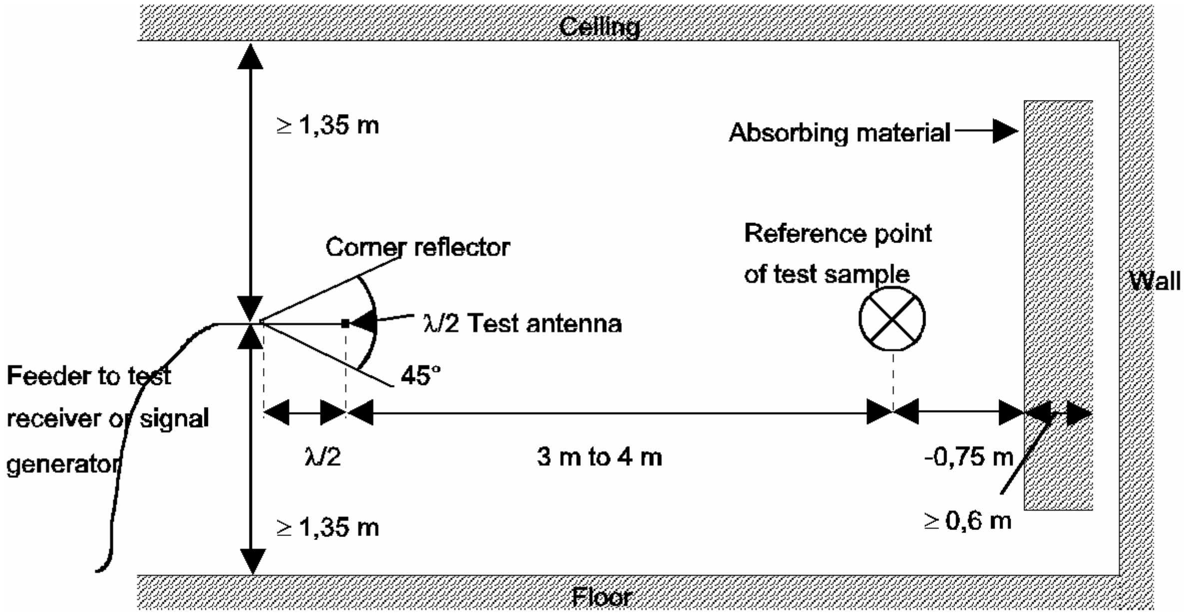


Figure C.2: Indoor site arrangement (shown for horizontal polarization)

C.2 Guidance on the use of radiation test sites

For measurements involving the use of radiated fields, use may be made of a test site in conformity with the requirements of clause C.1. When using such a test site, the following conditions should be observed to ensure consistency of measuring results.

C.2.1 Measuring distance

Evidence indicates that the measuring distance is not critical and does not significantly affect the measuring results, provided that the distance is not less than $\lambda/2$ at the frequency of measurement, and the precautions described in this annex are observed. Measuring distances of 3 m, 5 m, 10 m and 30 m are in common use in European test laboratories.

C.2.2 Test antenna

Different types of test antenna may be used, since performing substitution measurements reduces the effect of the errors on the measuring results.

Height variation of the test antenna over a range of 1 m to 4 m is essential in order to find the point at which the radiation is a maximum.

Height variation of the test antenna may not be necessary at the lower frequencies below about 100 MHz.

C.2.3 Substitution antenna

Variations in the measuring results may occur with the use of different types of substitution antenna at the lower frequencies below about 80 MHz.

Where a shortened dipole antenna is used at these frequencies, details of the type of antenna used should be included with the results of the tests carried out on the site. Correction factors shall be taken into account when shortened dipole antennas are used

C.2.4 Artificial antenna

The dimensions of the artificial antenna used during radiated measurements should be small in relation to the sample under test.

Where possible, a direct connection should be used between the artificial antenna and the test sample.

In cases where it is necessary to use a connecting cable, precautions should be taken to reduce the radiation from this cable by, for example, the use of ferrite cores or double screened cables.

C.2.5 Auxiliary cables

The position of auxiliary cables (power supply and microphone cables etc.) which are not adequately decoupled may cause variations in the measuring results. In order to get reproducible results, cables and wires of auxiliaries should be arranged vertically downwards (through a hole in the non conducting support).

C.2.6 Acoustic measuring arrangement

When carrying out measurements of the maximum usable sensitivity (radiated) of the receiver, the audio output shall be monitored by acoustically coupling the audio signal from the receiver loudspeaker/transducer to the test microphone. On the radiation test site all conducting materials shall be placed below the ground surface and the acoustic signal is conveyed from the receiver to the test microphone in a non-conducting acoustic pipe.

The acoustic pipe shall have an appropriate length. The acoustic pipe shall have an inner diameter of 6 mm and a wall thickness of 1,5 mm. A plastic funnel of a diameter corresponding to the receiver loudspeaker/transducer shall be attached to the receiver surface centred in front of the receiver loudspeaker/transducer. The plastic funnel shall be very soft at the attachment point to the receiver in order to avoid mechanical resonance. The narrow end of the plastic funnel shall be connected to the one end of the acoustic pipe and the test microphone to the other.

C.3 Further optional alternative indoor test site using an anechoic chamber

For radiation measurements when the frequency of the signals being measured is greater than 30 MHz, use may be made of an indoor site being a well-shielded anechoic chamber simulating free space environment. If such a chamber is used, this shall be recorded in the test report.

The test antenna, measuring receiver, substitution antenna and calibrated signal generator are used in a way similar to that of the general method, clause C.1. In the range between 30 MHz and 100 MHz some additional calibration may be necessary.

An example of a typical measurement site may be an electrically shielded anechoic chamber being 10 m long, 5 m broad and 5 m high.

Walls and ceiling should be coated with RF absorbers of 1 m height.

The base should be covered with absorbing material 1 m thick, and a wooden floor, able to carry test equipment and operators.

A measuring distance of 3 m to 5 m in the long middle axis of the chamber can be used for measurements up to 12,75 GHz.

The construction of the anechoic chamber is described in the following clauses.

C.3.1 Example of the construction of a shielded anechoic chamber

Free-field measurements can be simulated in a shielded measuring chamber where the walls are coated with RF absorbers.

Figure C.3 shows the requirements for shielding loss and wall return loss of such a room.

As dimensions and characteristics of usual absorber materials are critical below 100 MHz (height of absorbers < 1 m, reflection attenuation < 20 dB) such a room is preferably suitable for measurements above 100 MHz.

Figure C.4 shows the construction of a shielded measuring chamber having a base area of 5 m by 10 m and a height of 5 m.

Ceilings and walls are coated with pyramidal formed absorbers approximately 1 m high. The base is covered with absorbers which are able to carry and which forms a sort of floor.

The available internal dimensions of the room are 3 m $\times$ 8 m $\times$ 3 m, so that a measuring distance of maximum 5 m length in the middle axis of this room is available.

At 100 MHz the measuring distance can be extended up to a maximum of 2 λ.

The floor absorbers reject floor reflections so that the antenna height need not be changed and floor reflection influences need not be considered.

All measuring results can therefore be checked with simple calculations and the measuring tolerances have the smallest possible values due to the simple measuring configuration.

For special measurements it can be necessary to re-introduce floor reflections. Taking away the floor absorbers would mean a removal of approximately 24 m^3 absorber material. Therefore the floor absorbers are covered with metal plates of metallic nets instead.

C.3.2 Influence of parasitic reflections in anechoic chambers

For free-space propagation in the far field condition the correlation $E = E_o (R_o/R)$ is valid for the dependence of the field strength E on the distance R, whereby E_o is the reference field strength in the reference distance R_o.

It is useful to use just this correlation for comparison measurements, as all constants are eliminated with the ratio and neither cable attenuation nor antenna mismatch or antenna dimensions are of importance.

Deviations from the ideal curve can be seen easily if the logarithm of the above equation is used, because the ideal correlation of field strength and distance can then be shown as a straight line and the deviations occurring in practice are clearly visible. This indirect method shows the disturbances due to reflections more readily and is far less problematical than the direct measurement of reflection attenuation.

With an anechoic chamber of the dimensions suggested in clause C.3 at low frequencies up to 100 MHz there are no far field conditions, and therefore reflections are stronger so that careful calibration is necessary.

In the medium frequency range from 100 MHz to 1 GHz the dependence of the field strength on the distance meets the expectations very well.

In the frequency range of 1 to 12,75 GHz, because more reflections will occur, the dependence of the field strength on the distance will not correlate so closely.

C.3.3 Calibration of the shielded anechoic chamber

Careful calibration of the chamber shall be performed over the range 30 MHz to 12,75 GHz.

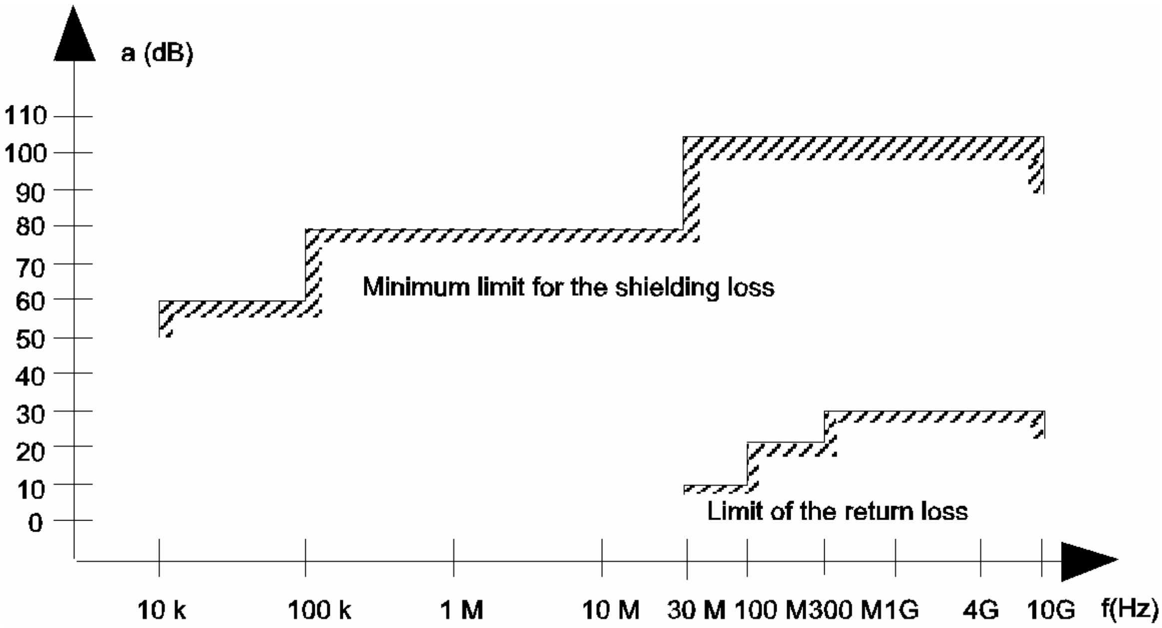
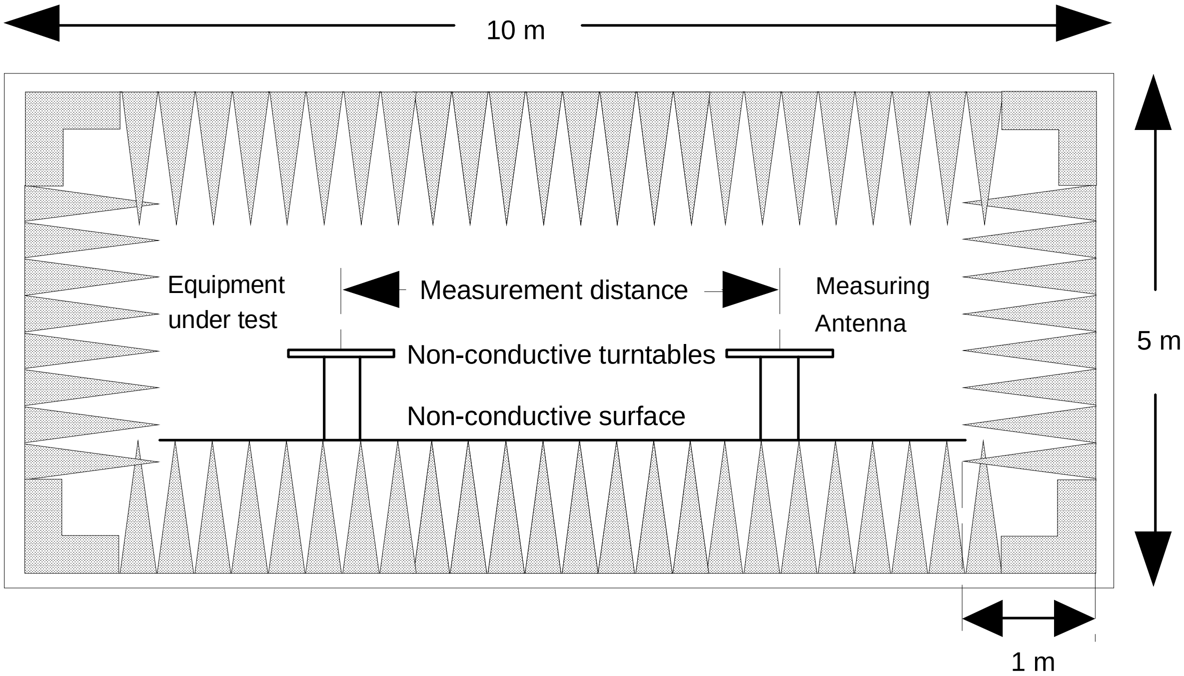


Figure C.3: Specifications for shielding and reflections



Ground plan

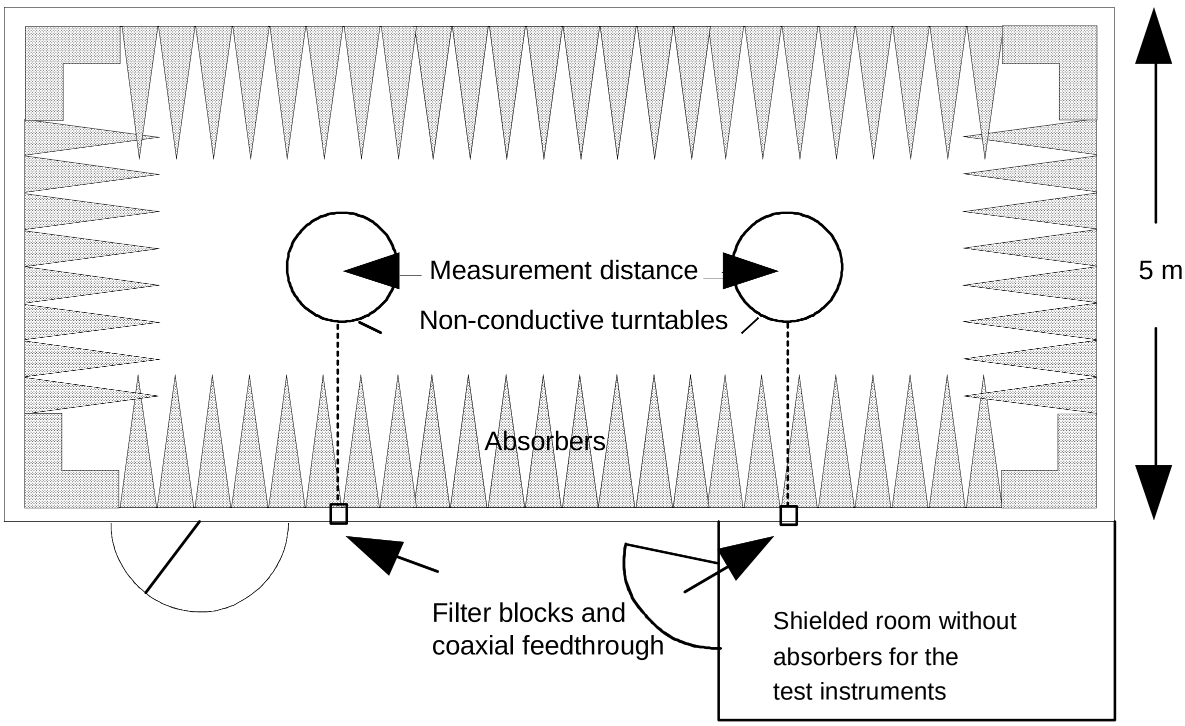


Figure C.4: Example of construction of an anechoic shielded chamber

Annex D (normative): DSC Calls

Table D.1: DSC calls

Format Specifier	Category	1st Telecommand (Symbol No.)	Receive	Transmit
Distress		F3E/G3E simplex (100)	X	X
All ships	Distress	Distress Ack (110)	X	
All ships	Distress	Distress Relay (112)	X	
All ships	Urgency	F3E/G3E simplex (100)	X	X
All ships	Safety	F3E/G3E simplex (100)	X	X
Individual	Urgency	F3E/G3E simplex (100)	X	
Individual	Safety	F3E/G3E simplex (100)	X	
Individual	Routine	F3E/G3E simplex (100)	X	X
Group	Routine	F3E/G3E simplex (100)	X	X
2nd Telecommand Transmit and Receive (126) No information				

Table D.2: DSC calls to ITU-R Recommendation M.821-1 [8]

Expansion data specifier	Receive	Transmit
100 Enhanced position resolution	X	X

Annex E (informative): Bibliography

- ETSI EN 301 025-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF radiotelephone equipment for general communications and associated equipment for class "D" Digital Selective Calling (DSC); Part 1: Technical characteristics and methods of measurement".

Annex F (informative): The EN title in the official languages

Language	EN title
Czech	
Danish	Elektromagnetisk kompatibilitet og Radiospektrum Anliggender (ERM); VHF radiotelefoni udstyr til generel kommunikation og tilknyttet udstyr til "Klasse D" Digitale, selektive opkald (DSC); Del 2: Harmoniseret EN, som dækker de væsentlige krav i R&TTE direktivets artikel 3.2
Dutch	Elektromagnetische compatibiliteit en radiospectrum zaken (ERM); VHF radiotelefonie apparatuur tbv algemene communicatie en bijbehorende apparatuur voor klasse "D" Digital Selective Calling (DSC); Deel 2: Geharmoniseerde EN welke invulling geeft aan de wezenlijke vereisten, neergelegd in artikel 3.2 va de R&TTE Directive
English	Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF radiotelephone equipment for general communications and associated equipment for class "D" Digital Selective Calling (DSC); Part 2: Harmonized EN under article 3.2 of the R&TTE Directive
Estonian	
Finnish	Sähkömagneettinen yhteensopivuus ja radiospektriasiat (ERM); Yleisen liikenteen meri-VHF -radiopuhelimet ja D-luokan digitaalisen selektiivikutsun (DSC) lisälaitteet; Osa 2: Harmonisoitu EN R&TTE - direktiivin artiklan 3.2 olennaisten vaatimusten mukaisesti
French	CEM et spectre radioélectrique (ERM) - Appareils de radiotéléphone en VHF pour la téléphonie générale et appareils associés pour Appel numérique sélectif (DSC) de classe "D" - Partie 2: EN harmonisée de l"article 3.2 de la Directive R&TTE
German	Elektromagnetische Verträglichkeit und Funkspektrumangelegenheiten (ERM); UKW-Sprechfunkanlagen des mobilen Seefunkdienstes für "allgemeine Kommunikation" mit Zusatzeinrichtung für den digitalen Selektivruf (DSC) Klasse D; Teil 2: Harmonisierte Europäische Norm (EN) mit wesentlichen Anforderungen nach R&TTE-Richtlinie Artikel 3.2
Greek	Ηλεκτρομαγνητική συμβατότητα και θέματα Ραδιοφάσματσς (ERM) - Συσκευή ραδιοτηλε-φώνου VHF γενικώ επικοινωνιών και συσχε-τισμένο εξοπλισμό για Ψηφιακή Επιλεκτική Κλήση (DSC) κατηγοριας "D" - Μέρος 2: Εναρμονισμένο EN για την κάλυψη των ουσιω-δών απαιτήσεων του άρθρου 3.2 της οδηγίας R&TTE
Hungarian	
Icelandic	
Italian	Compatibilità elettromagnetica e Questioni relative allo spettro delle radiofrequenze (ERM); apparecchiature radiotelefoniche VHF per comunicazioni generiche ed apparecchiature associate per Chiamate Digitali Selettive (DSC) di Classe "D"; Part 2: Norma Europea armonizzata per l'articolo 3.2 della direttiva R&TTE
Latvian	
Lithuanian	
Maltese	
Polish	Kompatybilność Elektromagnetyczna i Zagadnienia Widma Radiowego (ERM) - Urządzenia radiotelefoniczne VHF dla łączności ogólnej i związane wyposażenie do wywoływania selektywnego cyfrowego (DSC) "klasy D" - Część 2: Zharmonizowana EN zgodna z artykułem 3.2 dyrektywy R&TTE
Portuguese	Assuntos de Espectro Radioeléctrico e Compatibilidade Electromagnética (ERM); Equipamento radiotelefónico VHF destinado a comunicações genéricas e equipamento associado para Chamada Selectiva Digital (DSC) de Classe "D"; Parte 2: EN harmonizada cobrindo os requisitos essenciais no âmbito do Artigo 3.2 da Directiva R&TTE
Slovak	Elektromagnetická kompatibilita a záležitosti rádiového spektra (ERM). Rádiotelefónne zariadenia VHF na všeobecné komunikácie a pridružené zariadenia triedy D digitálneho selektívneho volania (DSC). Časť 2: Harmonizovaná EN vzťahujúca sa na základné požiadavky podľa článku 3.2 smernice R&TTE
Slovenian	
Spanish	Compatibilidad electromagnética y cuestiones de espectro de radiofrecuencia (ERM); Equipos radioteléfono VHF para comunicaciones generales y equipos asociados para clase "D" Llamada selectiva digital (DSC); Parte 2: EN armonizada cubriendo los requisitos esenciales según el artículo 3.2 de la directiva de R&TTE
Swedish	Elektromagnetisk kompatibilitet och radio-spektrumfrågor (ERM); Radiotelefonutrustning på VHF avsedd för allmänna kommunikationer och associerad utrustning för Klass "D" digitalt selektivt anrop (DSC); Del 2: Harmoniserad EN enligt artikel 3.2 i R&TTE-direktivet

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