Final draft EN 300 220-1 V1.2.1 (1997-08)

European Standard (Telecommunications series)

Electromagnetic compability and Radio spectrum Matters (ERM); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Parameters intended for regulatory purposes

European Telecommunications Standards Institute

Reference
REN/ERM-RP08-0107-1 (21c90ioo.PDF)
formerly REN/RES-08-0107-1

Keywords
Radio, testing, SRD

ETSI Secretariat

Postal address
F-06921 Sophia Antipolis Cedex - FRANCE

Office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

X.400
c= fr; a=atlas; p=etsi; s=secretariat

Internet
secretariat@etsi.fr
http://www.etsi.fr

Contents

Intellectual Property Rights

ETSI has not been informed of the existence of any Intellectual Property Right (IPR) which could be, or could become essential to the present document. However, pursuant to the ETSI Interim IPR Policy, no investigation, including IPR searches, has been carried out. No guarantee can be given as to the existence of any IPRs which are, or may be, or may become, essential to the present document.

Foreword

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

The present document, together with ETS 300 683, is intended to become a Harmonized EMC Standard which is intended to be published in the Official Journal of the European Communities referencing Council Directive 89/336/EEC "Council Directive on the approximation of the laws of the member States relating to electromagnetic compatibility ("the EMC Directive").

The technical parameters which are relevant to the EMC Directive are listed in annex E.

The present document consists of two parts as follows:

Part 1: "Parameters intended for regulatory purposes";

Part 2: "Supplementary parameters not intended for regulatory purposes".

Clauses 1 and 3 provide a general description on the types of equipment covered by the present document and the definitions and abbreviations used. Clause 4 provides a guide as to the number of samples required in order that type tests may be carried out, and any markings on the equipment which the applicant should provide.

Clause 7 gives the maximum measurement uncertainty values.

Clauses 8 and 9 specify the spectrum utilization parameters which are required to be measured. These are the maximum limits which have been chosen to minimize harmful interference to other equipment and services. The clauses provide details on how the equipment should be tested and the conditions which should be applied.

Annex A provides specifications concerning radiated measurements.

Annex B contains specifications for adjacent channel power measurement arrangements.

Annex C provides information on the spectrum analyser specification.

Annex D is a graphical representation of subclause 4.1, referring to the presentation of equipment for testing purposes.

Annex E provides information on the parameters relevant to the EMC 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):	6 months after doa

1 Scope

The present document covers the minimum characteristics considered necessary for Short Range Devices (SRD) in order to make the best use of the available frequencies. The term "The present document" refers to EN 300 220-1 only.

The present document contains the technical characteristics for radio equipment referencing CEPT/ERC Decisions and Recommendation CEPT ERC/Recommendation 70-03 [1]

The present document does not necessarily include all the characteristics which may be required by a user, nor does it necessarily represent the optimum performance achievable. It is a product family standard which may be completely or partially superseded by specific standards covering specific applications.

The present document applies to short range devices:

- either with a Radio Frequency (RF) output connection and/or with an integral antenna;
- for alarms, identification, telecommand, telemetry, etc., applications;
- with or without speech;
- operating on radio frequencies between 25 MHz and 1 000 MHz, with power levels up to 500 mW, radiated or conducted.

The parameters in clauses 8 and 9 of the present document are considered as spectrum utilization parameters. It is intended that these parameters will be measured by an accredited test laboratory for the purpose of type testing and approval.

The present document covers fixed stations, mobile stations and portable stations. In the present document basic requirements are given for the different frequency bands, channel separations etc., where appropriate.

All types of modulation are covered, in the present document, provided the requirements of subclauses 8.5 or 8.6, whichever is applicable, are met.

The radio equipment, covered by the classification SRD is divided into several classes based on maximum output power (see table 1). The class designation is based on CEPT/ERC Recommendation 70-03 [1].

Table 1

Class	Power level (conducted or radiated) mW
7a	5
8	10
9	25
F	100
12	500

For non-harmonized parameters, national regulatory conditions can apply regarding the type of modulation, channel/frequency separations, maximum transmitter output power/effective radiated power, duty cycle, equipment marking and the inclusion of an automatic transmitter shut-off facility as a condition of the issue of an individual or general licence, or, as a condition of use under licence exemption. The extreme temperature ranges are fixed and are given in subclause 5.4.1.2.

The present document does not require measurements for radiated emissions below 25 MHz.

Additional standards or specifications can be required for equipment such as that intended for connection to the Public Switched Telephone Network (PSTN).

2 Normative references

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] draft CEPT/ERC Recommendation 70-03 (1997): "Relating to the use of Short Range Devices (SRD)".

[2] ITU-T Recommendation 0.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

[3] CISPR 16: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".

[4] ETR 028: "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".

[5] ETS 300 113 (1996): "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment intended for the transmission of data (and speech) and having an antenna connector".

[6] ETS 300 390 (1996): "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment intended for the transmission of data (and speech) and using an integral antenna".

[7] ETS 300 683 (1997): "Radio Equipment and Systems (RES); ElectroMagnetic Compatibility (EMC) standard for Short Range Devices (SRD) operating on frequencies between 9 kHz and 25 GHz".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

alarm: The use of radio communication for indicating an alarm condition at a distant location.

assigned frequency band: The frequency band within which the device is authorized to operate.

conducted measurements: Measurements which are made using a direct 50 Ω connection to the equipment under test.

dedicated antenna: A removable antenna supplied and type tested with the radio equipment, designed as an indispensable part of the equipment.

fixed station: Equipment intended for use in a fixed location.

full tests: All tests specified in the present document.

integral antenna: A permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment.

limited tests: The limited tests, see subclauses 4.1.1 to 4.1.10, are as follows:

- transmitter frequency error, see subclause 8.1;
- transmitter carrier power conducted, see subclause 8.2;
- transmitter effective radiated power, see subclause 8.3;
- transmitter adjacent channel power, see subclause 8.5.

mobile station: Equipment normally fixed in a vehicle.

portable station: Equipment intended to be carried, attached or implanted.

radiated measurements: Measurements which involve the absolute measurement of a radiated field.

telecommand: The use of radio communication for the transmission of signals to initiate, modify or terminate functions of equipment at a distance.

telemetry: The use of radio communication for indicating or recording data at a distance.

wideband: Equipment to be used in a non-channelized continuous frequency band covering more than 25 kHz, or to be used in a channelized frequency band with a channel spacing greater than 25 kHz.

3.2 Symbols

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

AR0, AR1, ...	categories of Alignment Range (see subclause 4.1.3)
dB	decibel
E	field strength
FR_L	Lower end of Frequency Range
FR_C	Centre of Frequency Range
FR_H	Higher end of Frequency Range
FT	Full Test (see subclause 3.1)
LT	Limited Tests (see subclause 3.1.)
NaCl	sodium chloride
Eo	reference field strength
R	distance
Ro	reference distance
SND/ND	Signal + Noise + Distortion / Noise + Distortion
λ	wavelength

3.3 Abbreviations

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

ac/AC	alternative current
EMC	ElectroMagnetic Compatibility
emf	electromotive force
ERP	Effective Radiated Power
IF	Intermediate Frequency
ISM	Industrial, Scientific and Medical
ITE	Information Technology Equipment
MPAD	Maximum Permissible Amplitude modulation Depth
MPFD	Maximum Permissible Frequency Deviation
OFR	Operating Frequency Range
PSTN	Public Switched Telephone Network

RF	Radio Frequency
rms	root-mean-square
SR	Switching Range
SRD	Short Range Device
Tx	Transmitter
VSWR	Voltage Standing Wave Ratio

4 General

4.1 Presentation of equipment for testing purposes

Each equipment submitted for type testing shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

The applicant should choose the appropriate frequencies for testing in consultation with the Administration(s) from whom type approval is sought and in accordance with subclauses 4.1.5 to 4.1.12 (see annex D).

If an equipment is designed to operate with different carrier powers, measurement of each transmitter parameter shall be performed at the lowest and highest power level at which the transmitter is intended to operate.

To simplify and harmonize the type testing procedures between the different testing laboratories, measurements shall be performed, according to the present document, on samples of equipment defined in subclauses 4.1.1 to 4.1.12 (see also annex D).

These subclauses are intended to give confidence that the requirements set out in the present document have been met without the necessity of performing measurements on all frequencies.

4.1.1 Choice of model for type testing

The applicant shall provide one or more samples of the equipment, as appropriate, for type testing.

If an equipment has several optional features, considered not to affect the RF parameters then tests need only be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the applicant and agreed by the test laboratory.

In the case of hand portable equipment without a 50 Ω external antenna connector, see subclause 4.1.12.

4.1.2 Definitions of Switching Range (SR), alignment range and operational frequency range

4.1.2.1 Definition of SR

The applicant shall state the SR of the receiver and the transmitter (which may differ).

The SR is the maximum frequency range, as specified by the applicant, over which the receiver or the transmitter can be operated within the alignment range without reprogramming or realignment.

4.1.2.2 Definition of alignment range

The applicant shall also, when submitting equipment for type testing, state the alignment ranges for the receiver and the transmitter.

The alignment range is defined as the frequency range over which the receiver and/or the transmitter can be programmed and/or aligned to operate, without any change to the circuit other than the substitution of programmable read only memories or crystals (for the receiver and transmitter) and the trimming of discrete components.

Trimming is an act by which the value (in this case relating to frequency) of a component is changed within the circuit. This act may include the physical alteration, substitution (by components of similar size and type) or activation/de-activation (via the setting of soldered bridges) of components.

For the purpose of all measurements, the receiver and transmitter shall be considered separately.

4.1.2.3 Definition of operating frequency range

The Operating Frequency Range (OFR) is the total range of frequencies covered either by one type, or by a family of equipment.

It is noted that a family of equipment may be capable of covering a wider frequency range than the alignment frequency range of one type of equipment.

4.1.3 Definition of the categories of the alignment range (AR0, AR1, AR2 and AR3)

The alignment range falls into one of four categories:

The first category, defined as AR0, corresponds to equipment having an alignment range of less than or equal to 5 MHz.

The second category, defined as AR1, corresponds to an alignment range greater than 5 MHz but less than or equal to 30 MHz.

The third category, defined as AR2, corresponds to an alignment range greater than 30 MHz, but less than or equal to 60 MHz.

The fourth category, defined as AR3, corresponds to an alignment range greater than 60 MHz.

4.1.4 Testing of equipment of category AR0

Full tests (see subclause 3.1) shall be carried out on a frequency within 50 kHz of the centre frequency of the alignment range, category AR0.

4.1.5 Testing of equipment of category AR1

Full tests (see subclause 3.1) shall be carried out on a frequency within 50 kHz of the highest frequency of the alignment range, and full tests (see subclause 3.1) on a frequency within 50 kHz of the lowest frequency of the alignment range.

4.1.6 Testing of equipment of category AR2

Full tests (see subclause 3.1) shall be carried on a frequency within 50 kHz of the highest frequency of the alignment range and full tests on a frequency within 50 kHz of the lowest frequency of the alignment range.

Limited tests (see subclause 3.1) shall be carried out on a frequency within 50 kHz of the centre frequency of the alignment range.

4.1.7 Testing of equipment of category AR3

Full test (see subclause 3.1) shall be carried out on 2 frequencies, one within 50 kHz of the highest, and one within 50 kHz of the lowest frequency of the alignment range.

Limited tests (see subclause 3.1) shall be carried out on intermediate test frequencies, equally spaced (±50 kHz) over the alignment range and chosen such that the gaps between the test frequencies do not exceed 30 MHz.

4.1.8 Testing of equipment capable of being aligned to operate with more than one frequency separation

If an equipment can be programmed and/or aligned to operate without any physical change of components other than programmable read only memories or crystals, with more than one frequency separation, the measurements shall be made in accordance with subclauses 4.1.4, 4.1.5, 4.1.6, and 4.1.7, for frequency separations of 10 kHz, 12,5 kHz, 20 kHz or 25 kHz as indicated in table 2.

4.1.9 Number of samples for testing

If the SR of each equipment corresponds to its alignment range category (AR0, AR1, AR2, or AR3), then only one sample shall be tested (see figure D.1).

If the SR of the equipment is a subset of the equipment's alignment range, then the following samples shall be tested in order to cover the whole of that assignment range:

- for category AR0, one sample shall be provided for testing on a frequency in the vicinity of the centre of the alignment range AR0, as specified in subclause 4.1.4;
- for category AR1, two samples shall be provided, one sample for testing at a frequency close to the upper edge and the other sample for testing close to the lower edge of the alignment range AR1, as specified in subclause 4.1.5;
- for category AR2, three samples shall be provided, one sample for testing at a frequency close to the upper edge, one sample for testing close to the lower edge and the other sample for testing in the vicinity of the centre of the alignment range AR2, as specified in subclause 4.1.6;
- for category AR3, four or more samples shall be provided, one sample for testing at a frequency close to the upper edge, one sample for testing close to the lower edge, and two or more samples for testing at a corresponding number of intermediate frequencies, as specified in subclause 4.1.7.

See clause D.2 for details of the number of samples and tests.

Table 2: Measurements for equipment with more than one frequency separation

Alignment Range	**10, 12,5, 20 or 25 kHz (note 2)**		
	FR_L	FR_C	FR_H
AR0	-	FT	-
AR1	FT	-	FT
AR2	FT	LT (note 1)	FT
AR3	FT	LT (note 3)	FT

FT Full test (see subclause 3.1)
LT Limited tests (see subclause 3.1)
FR_L Lower end of frequency range
FR_C Centre of frequency range
FR_H Higher end of frequency range

NOTE 1: Limited tests for AR2 need only be performed on a frequency in the centre of the frequency range for either 10/12,5 kHz or 20/25 kHz frequency separation.

NOTE 2: If measurements are performed with a frequency separation of 10 kHz, there is no need to perform tests with a frequency separation of 12,5 kHz and vice-versa. Similarly, if measurements are performed with a frequency separation of 20 kHz, there is no need to perform tests with a frequency separation of 25 kHz and vice-versa.

NOTE 3: For equipment of category AR3, limited tests shall be performed on test frequencies at intermediate frequencies of the alignment range (see subclause 4.1.7).
The alignment range and frequencies used for the measurements shall be noted in the test report.

4.1.10 Testing of a family of equipment with a total operating range in excess of each equipment's alignments range

A family of equipment may be capable of covering a wider frequency range than the alignment range of one type of equipment by the use of frequency range determining components other than those specified in subclause 4.1.2 and fulfilling appropriate requirements.

If this is the case, then for the purposes of type testing, the operational frequency range shall be presented as two or more alignment ranges, as appropriate, each of which is considered to be category AR0, AR1, AR2, or AR3, according to the definition in subclause 4.1.3.

Full tests (see subclause 3.1) shall be carried out on a frequency within 50 kHz of the highest frequency of the OFR and full tests shall be carried out on a frequency within 50 kHz of the lowest frequency of the OFR.

For category AR1, limited tests shall be carried out on a frequency within 50 kHz of the outer edges of the alignment range within the OFR.

For category AR2, tests shall be in accordance with subclause 4.1.6.

For category AR3, tests shall be in accordance with subclause 4.1.7.

See clause D.3 for examples.

4.1.11 Testing of equipment with alternative power levels

If a family of equipment has alternative output power levels provided by the use of separate power modules or add on stages, or additionally has alternative frequency separations (as described in subclause 4.1.8), then each module or add on stage shall be tested in combination with the equipment. The necessary samples and tests can be proposed by the applicant and/or test laboratory and shall be agreed with the Administration(s), based on the requirements of subclause 4.1.

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

4.1.12.1 Equipment with an internal permanent or temporary antenna connector

The means to access and/or implement the internal permanent or temporary antenna connector shall be stated by the applicant with the aid of a diagram. The fact that use has been made of the internal antenna connection, or of a temporary connection, to facilitate measurements shall be recorded in the test report.

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

4.1.12.2 Equipment with a temporary antenna connector

The applicant, may submit one set of equipment with the normal antenna connected, to enable the radiated measurements to be made. He shall attend the test laboratory at conclusion of the radiated measurements, to disconnect the antenna and fit the temporary connector. The testing laboratory staff shall not connect or disconnect any temporary antenna connector.

Alternatively, the applicant may submit two sets of equipment to the test laboratory, one fitted with a temporary antenna connector with the antenna disconnected and the other with the antenna connected. Each equipment shall be used for the appropriate tests. The applicant shall declare that two sets of equipment are identical in all respects.

4.2 Mechanical and electrical design

4.2.1 General

The equipment submitted by the manufacturer, or his representative, shall be designed, constructed and manufactured in accordance with good engineering practice, and with the aim of minimizing harmful interference to other equipment and services.

Transmitters and receivers may be individual or combination units, but shall operate with the correct power source.

4.2.2 Controls.

Those controls which, if maladjusted, may increase the interfering potential of the equipment, shall not be easily accessible to the user.

4.2.3 Transmitter shut-off facility

If the transmitter is equipped with an automatic transmitter shut-off facility, it should be made inoperative for the duration of the test.

4.2.4 Marking

The equipment shall be marked in a visible place. This marking shall be legible and durable.

4.2.4.1 Equipment identification

The marking shall include as a minimum:

- the name of the applicant or his trade mark;
- the type designation.

4.2.4.2 Regulatory marking

The equipment shall be marked, where applicable, in accordance with CEPT/ERC Recommendation 70-03 [1]. Where this is not applicable the equipment shall be marked in accordance with national regulatory requirements.

4.2.5 Receiver mute or squelch

If the receiver is equipped with a mute, squelch or battery-saving circuit, this circuit shall be made inoperative for the duration of the tests.

4.3 Declarations by the applicant

When submitting equipment for type testing, the applicant shall supply the necessary information according to the appropriate application form.

4.4 Auxiliary test equipment

All necessary test signal sources and setting up information shall accompany the equipment when it is submitted for type testing.

4.5 Interpretation of the measurement results

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

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the measurement uncertainty value for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 5 (see clause 7).

5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

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

The test conditions and procedures shall be as specified in subclauses 5.2 to 5.5.

5.2 Test power source

The equipment shall be tested using the appropriate test power source as specified in subclauses 5.2.1 or 5.2.2. Where equipment can be powered using either external or internal power sources, then equipment shall be tested using the external test power source as specified in subclause 5.2.1 then repeated using the internal power source as specified in 5.2.2.

The test power source used shall be stated on the test report.

5.2.1 External test power source

During type tests, the power source of the equipment shall be replaced by an external test power source capable of producing normal and extreme test voltages as specified in subclauses 5.3.2 and 5.4.2. The internal impedance of the external test power source shall be low enough for its effect on the test results to be negligible. For the purpose of the tests, the voltage of the external test power source shall be measured at the input terminals of the equipment. The external test power source shall be suitably de-coupled and applied as close to the equipment battery terminals as practicable. For radiated measurements any external power, leads should be so arranged so as not to affect the measurements.

During tests, the external test power source voltages shall be within a tolerance $< \pm 1$ % relative to the voltage at the beginning of each test.

5.2.2 Internal test power source

For radiated measurements on portable equipment with integral antenna, fully charged internal batteries shall be used. The batteries used should be as supplied or recommended by the applicant. If internal batteries are used, at the end of each test the voltage shall be within a tolerance of $< \pm 5$ % relative to the voltage at the beginning of each test.

If appropriate, the external test power source may replace the supplied or recommended internal batteries at the required voltage, for conducted measurements or where a test fixture is used, this shall be stated on the test report.

5.3 Normal test conditions

5.3.1 Normal temperature and humidity

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

- temperature: +15°C to +35°C;
- relative humidity: 20 % to 75 %.

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests, shall be added to the test report.

5.3.2 Normal test power source

5.3.2.1 Mains voltage

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

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

5.3.2.2 Regulated lead-acid battery power sources

When the radio equipment is intended for operation from the usual types of regulated lead-acid battery power source the normal test voltage shall be 1,1 multiplied by the nominal voltage of the battery (6 V, 12 V, etc.).

5.3.2.3 Other power sources

For operation from other power sources or types of battery (primary or secondary), the normal test voltage shall be that declared by the equipment applicant and agreed by the accredited test house. Such values shall be stated in the test report.

5.4 Extreme test conditions

5.4.1 Extreme temperatures

5.4.1.1 Procedure for tests at extreme temperatures

Before measurements are made, the equipment shall have reached thermal balance in the test chamber. The equipment shall be switched off during the temperature stabilizing period.

In the case of equipment containing temperature stabilization circuits designed to operate continuously, the temperature stabilization circuits shall be switched on for 15 minutes after thermal balance has been obtained, and the equipment shall then meet the specified requirements.

If the thermal balance is not checked by measurements, a temperature stabilizing period of at least one hour, or such period as may be decided by the accredited test laboratory, shall be allowed. The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

5.4.1.1.1 Procedure for equipment designed for continuous operation

If the applicant states that the equipment is designed for continuous operation, the test procedure shall be as follows:

- before tests at the upper extreme temperature, the equipment shall be placed in the test chamber and left until thermal balance is attained. The equipment shall then be switched on in the transmit condition for a period of half an hour after which the equipment shall meet the specified requirements;
- for tests at the lower extreme temperature, the equipment shall be left in the test chamber until thermal balance is attained, then switched to the on condition for a period of one minute after which the equipment shall meet the specified requirements.

5.4.1.1.2 Procedure for equipment designed for intermittent operation

If the applicant states that the equipment is designed for intermittent operation, the test procedure shall be as follows:

- before tests at the upper extreme temperature, the equipment shall be placed in the test chamber and left until thermal balance is attained in the oven. The equipment shall then either:
  - transmit on and off according to the applicants declared duty cycle for a period of five minutes;

    or, if the applicants declared "on" period exceeds one minute then:
  - transmit in the on condition for a period not exceeding one minute, followed by a period in the off or standby mode for four minutes;

  after which the equipment shall meet the specified requirements.
- for tests at the lower extreme temperature the equipment shall be left in the test chamber until thermal balance is attained, then switched to the standby or receive condition for one minute after which the equipment shall meet the specified requirements when switched on in the transmit mode.

5.4.1.2 Extreme temperature ranges

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in subclause 5.4.1.1, at the upper and lower temperatures of one of the ranges specified in table 3.

Table 3: Extreme temperature ranges

Category I (General):	-20°C to +55°C;
Category II (Portable equipment):	-10°C to +55°C;
Category III (Equipment for normal indoor use):	0°C to +55°C.
NOTE: The term "equipment for normal indoor use" is taken to mean that the room temperature is controlled and the minimum indoor temperature is equal to or greater than 5°C.	

The test report form shall state which range is used.

5.4.2 Extreme test source voltages

5.4.2.1 Mains voltage

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

5.4.2.2 Regulated lead-acid battery power sources

When the radio equipment is intended for operation from the usual type of regulated lead-acid battery power sources, the extreme test voltages shall be 1,3 and 0,9 multiplied by the nominal voltage of the battery (6 V, 12 V, etc.).

For float charge applications using "gel-cell" type batteries, the extreme test voltages shall be 1,15 and 0,85 multiplied by the nominal voltage of the declared battery voltage.

5.4.2.3 Power sources using other types of batteries

The lower extreme test voltages for equipment with power sources using batteries shall be as follows:

for equipment with a battery indicator, the end point voltage as indicated;

for equipment without a battery indicator, the following end point voltage shall be used:

for the Leclanché or the lithium type of battery:

0,85 multiplied by the nominal voltage of the battery;

for the nickel-cadmium type of battery:

0,9 multiplied the nominal voltage of the battery;

for other types of battery, the lower extreme test voltage for the discharged condition shall be declared by the equipment applicant.

The nominal voltage is considered to be the upper extreme test voltage in this case.

5.4.2.4 Other power sources

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those agreed between the equipment applicant and the accredited test laboratory and shall be recorded in the test report.

6 General conditions

6.1 Normal test signals and test modulation

The test modulating signal is a signal which modulates a carrier and is dependent upon the type of equipment under test and also the measurement to be performed.

6.1.1 Normal test signals for analogue speech

Normal test signals for analogue speech are specified as follows:

A-M1: a 1 000 Hz tone;

A-M2: a 1 250 Hz tone.

For angle modulation the normal level of the test signals A-M1 and A-M2 shall be that which produces a deviation of 12 % of the channel separation or any lower value as declared by the applicant as the normal operating level.

In the case of amplitude modulation, the normal level shall be that which produces a modulation ratio of 60 %, or any lower value, as declared by the applicant.

6.1.2 Normal test signals for data

Normal test signals for data are specified as follows:

D-M2: a test signal representing a pseudo-random bit sequence of at least 511 bits in accordance with ITU-T Recommendation 0.153 [2]. This sequence shall be continuously repeated. If the sequence cannot be continuously repeated then this and the actual method used shall be stated on the test report;

D-M3: a test signal shall be agreed between the accredited test laboratory and the applicant in the case where selective messages are used and are generated or decoded within the equipment. The agreed test signal may be formatted and may contain error detection and correction.

For angle modulation the normal level of the test signal D-M3 shall be that which produces a deviation of 20 % of the channel separation or any other value as declared by the applicant as the normal operating level.

In the case of amplitude modulation, the normal level shall be that which produces a modulation ratio of 60 % or any lower value as declared by the applicant, as the normal operating level.

6.2 Artificial antenna

Where applicable, tests shall be carried out using an artificial antenna which shall be a substantially non-reactive non-radiating load with a 50 Ω connected to the antenna connector. The Voltage Standing Wave Ratio (VSWR) at the 50 Ω connector shall not be greater than 1,2: 1 over the frequency range of the measurement.

6.3 Test fixture

With equipment intended for use with an integral antenna, and not equipped with a 50 Ω RF output connector, the applicant may supply a test fixture (see also subclause 4.1.12).

This test fixture is a radio frequency coupling device for coupling the integral antenna to a 50 Ω radio frequency terminal at the working frequencies of the equipment under test. This allows certain measurements to be performed using conducted measuring methods, however, only relative measurements may be performed.

In addition, the test fixture shall provide, where applicable:

- a connection to an external power supply;
- an audio interface either by direct connection or by an acoustic coupler;
- a connection to a data interface.

The performance characteristics of the test fixture shall be agreed upon with the accredited test laboratory and shall conform to the following basic parameters:

- the circuitry associated with the RF coupling shall contain no active or non-linear devices;
- the coupling loss shall not influence the measuring results;
- the coupling loss shall be independent of the position of the test fixture and be unaffected by the proximity of surrounding objects or people;
- the coupling loss shall be reproducible when the equipment under test is removed and replaced;
- the coupling loss shall remain substantially constant when the environmental conditions are varied.

6.4 Test sites and general arrangements for radiated measurements

For guidance on radiation test sites see annex A. Detailed descriptions of the radiated measurement arrangements are included in this annex.

6.5 Modes of operation of the transmitter

For the purpose of the measurements according to the present document, there should be a facility to operate the transmitter in an unmodulated state. The method of achieving an unmodulated carrier frequency, or special types of modulation patterns, may also be decided by agreement between the applicant and the accredited test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test. If it is not possible to provide an unmodulated carrier then this shall be stated in the test report.

For purposes of type testing, the normal test signal (see subclause 6.1) shall be applied to the input of the transmitter under test with the normal input device (e.g. microphone) disconnected.

6.6 Measuring receiver

The term measuring receiver refers to either a selective voltmeter or a spectrum analyser. The bandwidth of the measuring receiver shall be as given in table 4.

Table 4

Frequency being measured: f	Measuring receiver bandwidth
f < 150 kHz	200 Hz
150 kHz ≤ f < 30 MHz	9 kHz
30 MHz ≤ f < 1 000 MHz	120 kHz
1 000 MHz ≤ f	1 MHz

7 Measurement uncertainty

The accumulated measurement uncertainties of the test system in use for the parameters to be measured should not exceed those given in table 5, this is in order to insure that the measurements remain within an acceptable standard.

Table 5: Measurement uncertainty

RF frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	±0,75 dB
Maximum frequency deviation: - within 300 Hz and 6 kHz of audio frequency - within 6 kHz and 25 kHz of audio frequency	 ±5 % ±3 dB
Adjacent channel power	±3 dB
Conducted emission of transmitter, valid up to 12,75 GHz	±4 dB
Conducted emission of receivers	±3 dB
Radiated emission of transmitter, valid up to 4 GHz	±6 dB
Radiated emission of receiver, valid up to 4 GHz	±6 dB

For the test methods, according to the present document the uncertainty figures are valid to a confidence level of 95 % calculated according to the methods described in the ETR 028 [4].

8 Methods of measurement and limits for transmitter parameters

Where the transmitter is designed with an adjustable carrier power, then all transmitter parameters shall be measured using the highest power level, as declared by the applicant. The equipment shall then be set to the lowest carrier power setting, as declared by the applicant, and the measurements for spurious emissions shall be repeated (see subclause 8.7).

When making transmitter tests on equipment designed for intermittent operation, the duty cycle of the transmitter, as declared by the applicant on the application form, shall not be exceeded. The actual duty cycle used shall be stated on the test report form.

If the equipment is supplied with both a permanent external 50 Ω RF connector and a dedicated or integral antenna, then full tests shall be carried out using the external connector and in addition:

- effective radiated power (radiated) (see subclause 8.3);
- spurious emissions (see subclause 8.7).

Tests shall be carried out with the dedicated or integral antenna.

For wideband equipment, the frequency error (subclause 8.1) need not be measured as this taken into account in the range of modulation bandwidth measurement (subclause 8.6).

For narrow band equipment, the frequency error measurement (subclause 8.1) need not be made if the adjacent channel power measurement (subclause 8.5) under extreme conditions is measured. The applicant shall state on the application form the measurement to be applied to the equipment submitted for testing. The submitted equipment shall fulfil the requirements of the stated measurement.

8.1 Frequency error

This measurement shall be made if the equipment is capable of producing an unmodulated carrier. If the equipment is not capable of producing an unmodulated carrier, then the adjacent channel power (see subclause 8.5) shall also be measured under extreme test conditions (see subclause 5.4) and the limits in subclause 8.5.3 shall be met.

8.1.1 Definition

The frequency error of the transmitter is the difference between the measured unmodulated carrier frequency and the nominal frequency stated by the applicant.

8.1.2 Method of measurement

The carrier frequency shall be measured (in the absence of modulation) with the transmitter connected to an artificial antenna. A transmitter without a 50 Ω output connector may be placed in the test fixture (see subclause 6.3) connected to an artificial antenna. The measurement shall be made under normal test conditions (see subclause 5.3) and extreme test conditions (see subclause 5.4) (extreme temperature and supply voltage simultaneously).

8.1.3 Limits

The frequency error shall not exceed the values given in table 6 under normal, extreme or any intermediate set of conditions.

Table 6

Frequency separation (kHz)	**Frequency error limit (kHz)**				
	< 47 MHz	47 to 137 MHz	> 137 to 300 MHz	> 300 to 500 MHz	> 500 to 1 000 MHz
10/12,5	±0,60	±1	±1(b) ±1,50(m) ±2(p)	±1(b) ±1,50(m) ±2,5(p)	No value specified
20/25	±0,60	±1,35	±2	±2(mb) ±2,50(p)	±2,50(mb) ±3(p)
NOTE: b = fixed station (base) m = mobile station p = portable station					

8.2 Carrier power (conducted)

If the equipment is designed to operate with different carrier powers, the rated power for each level or range of levels shall be declared by the applicant.

These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

8.2.1 Definition

The carrier power is the average power delivered to the artificial antenna (see subclause 6.2) during one radio frequency cycle in the absence of modulation.

When it is not possible to measure the power in the absence of modulation, this fact shall be stated in the test report.

8.2.2 Method of measurement

This method applies only to equipment with a permanent external antenna connector. For equipment with an external antenna connector and supplied with a dedicated antenna, subclause 8.3 applies.

The transmitter shall be connected to an artificial antenna (see subclause 6.2) and the carrier or mean power delivered to this artificial antenna shall be measured under normal test conditions (see subclause 5.3).

In the case of pulse modulation equipment where it is not possible to make the measurement in the absence of modulation, the measurement shall be carried out by the use of a measuring receiver with bandwidth as stated in subclause 6.6 and quasi-peak detector set in accordance with the specification of CISPR 16 [3] section one for the bands C and D.

The measurement shall be repeated under extreme test conditions (see subclauses 5.4.1 and 5.4.2 applied simultaneously).

8.2.3 Limits

Under normal and extreme test conditions (see subclauses 5.3 and 5.4), the carrier output power (conducted) shall not exceed the maximum value given in table 7.

Table 7

Class	Power level mW
7a	5
8	10
9	25
11	100
12	500

8.3 Effective radiated power (radiated)

This measurement applies to equipment with an integral antenna and to equipment supplied with a dedicated antenna.

If the equipment is designed to operate with different carrier powers, the rated power for each level or range of levels shall be declared by the applicant.

These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

8.3.1 Definition

The effective radiated power is the power radiated in the direction of the maximum level under specified conditions of measurements in the absence of modulation.

When it is not possible to measure the power in the absence of modulation, this fact shall be stated in the test report.

8.3.2 Methods of measurement

On a test site, selected from annex A, the equipment shall be placed at the specified height on a support, as specified in annex A, and in the position closest to normal use as declared by the applicant.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

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

The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test.

In case of pulse modulation equipment where it is not possible to make the measurement in the absence of modulation, the measurement shall be carried out by the use of a measuring receiver with bandwidth as stated in subclause 6.6 and quasi-peak detector set in accordance with the specification of CISPR 16 [3] section one for the bands C and D.

The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.

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

The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.

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

The transmitter shall be replaced by a substitution antenna as defined in annex A, subclause A.2.3.

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 transmitter.

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

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

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

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

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

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

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

8.3.3 Limits

The effective radiated power shall not exceed the maximum value given in table 8.

Table 8

Class	Power level mW
7a	5
8	10
9	25
11	100
12	500

The measurement shall be carried out under normal test conditions only (see subclause 5.3).

8.4 Response of the transmitter to modulation frequencies

These measurements are not applicable for wideband equipment.

8.4.1 Frequency deviation

This measurement is only applicable for analogue speech (angle modulation).

8.4.1.1 Definition

The frequency deviation is the maximum difference between the instantaneous frequency of the frequency or phase modulated radio frequency signal and the carrier frequency in the absence of modulation.

8.4.1.2 Analogue signals within the audio bandwidth

8.4.1.2.1 Method of measurement

The transmitter shall be connected to the artificial antenna (see subclause 6.2). A transmitter without a 50 Ω output connector shall be placed in the test fixture (see subclause 6.3) connected to an artificial antenna. The frequency deviation shall be measured by means of a deviation meter capable of measuring the maximum permissible frequency deviation, including that due to any harmonics and intermodulation products which may be produced in the transmitter. The deviation meter bandwidth shall be suitable to accommodate the highest modulation frequency and to achieve the required dynamic range.

The modulation frequency shall be varied between 300 Hz and 3 000 Hz for equipment operating with 20 kHz or 25 kHz channel separations and between 300 Hz and 2 550 Hz for equipment operating with 10 kHz or 12,5 kHz channel separations. The level of the test signal shall be 20 dB above the level of the normal test signal A-M1 (see subclause 6.1.1), or 10 dB above in case of a transmitter with an integrated microphone.

The maximum (positive or negative) frequency deviation shall be recorded.

8.4.1.2.2 Limits

The maximum frequency deviation for transmitters equipped with speech facilities shall not exceed the values given in table 9.

Table 9

Channel separation	**Maximum permissible frequency deviation**
10 kHz	±2 kHz
12,5 kHz	±2,5 kHz
20 kHz	±4 kHz
25 kHz	±5 kHz

8.4.1.3 Analogue signals above the audio bandwidth

8.4.1.3.1 Method of measurement

The transmitter shall be connected to the artificial antenna (see subclause 6.2). A transmitter without a 50 Ω output connector shall be placed in the test fixture (see subclause 6.3) connected to an artificial antenna. The frequency deviation shall be measured by means of a deviation meter capable of measuring the maximum frequency deviation, including that due to any harmonics and intermodulation products which may be produced in the transmitter. The deviation meter bandwidth shall be suitable to accommodate the highest modulation frequency and to achieve the required dynamic range.

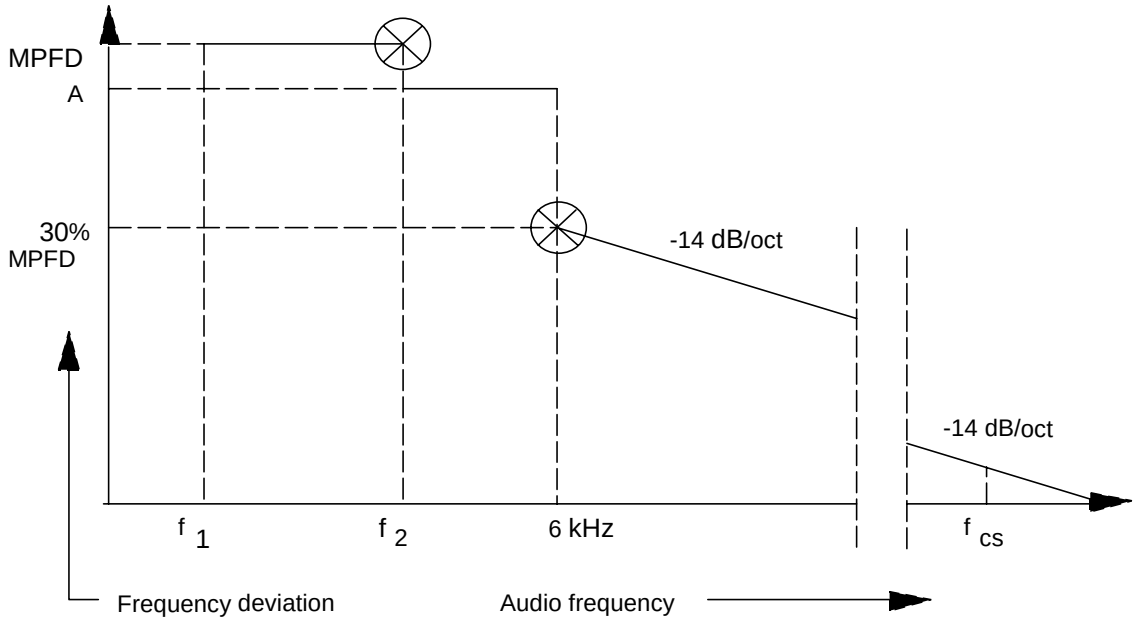
The modulation frequency shall be varied between 3 kHz for equipment operating with 20 kHz or 25 kHz channel separations or 2,55 kHz for equipment operating with 10 kHz or 12,5 kHz channel separations and the frequency equal to the channel separation with a level of the normal test signal A-M1 (see subclause 6.1.1).

The maximum (positive or negative) frequency deviation shall be recorded.

8.4.1.3.2 Limits

The frequency deviation at modulation frequencies below 6 kHz, shall not exceed the frequency deviation at a modulation frequency of 3 kHz/2,55 kHz. At 6 kHz, the deviation shall be not more than 30,0% of the maximum permissible frequency deviation (see table 9).

The frequency deviation at modulation frequencies between 6 kHz and a frequency equal to the channel separation for which the equipment is intended shall not exceed the value given by a linear representation of the frequency deviation (dB) relative to the modulation frequency, starting at the 6 kHz limit and having a slope of -14 dB per octave. These limits are illustrated in figure 1.



NOTE:

f_1:	300 Hz
f_2:	3,0 kHz (for 20 kHz or 25 kHz channel separation); or
	2,55 kHz (for 10 kHz or 12,5 kHz channel separation)
MPFD:	maximum permissible frequency deviation (see subclause 8.4.1.2.2)
A:	measured frequency deviation at f_2
f_{cs}:	frequency equal to channel separation

Figure 1

8.4.2 Modulation depth

This measurement is only applicable for analogue speech (amplitude modulation).

8.4.2.1 Definition

The modulation depth is the ratio of the difference between the maximum and minimum amplitude of the wave to the sum of these amplitudes.

8.4.2.2 Analogue signals within the audio bandwidth

8.4.2.2.1 Method of measurement

The transmitter shall be connected to the artificial antenna (see subclause 6.2). A transmitter without a 50 Ω output connector shall be placed in the test fixture (see subclause 6.3) connected to an artificial antenna. The modulation depth shall be measured by means of a modulation depth meter. The modulation depth meter shall be suitable to cover the required dynamic range.

The modulation frequency shall be varied between 300 Hz and 3 000 Hz for equipment operating with 20 kHz or 25 kHz channel separations, and between 300 Hz and 2 550 Hz for equipment operating with 10 kHz or 12,5 kHz channel separations. The level of the test signal shall be the level which produces a modulation depth of 60 %, or any lower value as declared by the applicant using A-M2 (see subclause 6.1.1). The level of the test signal shall then be increased by 20 dB, or 10 dB in the case of a transmitter with an integrated microphone. At each test frequency, the resulting modulation depth shall be recorded.

8.4.2.2.2 Limits

The maximum modulation depth is 100 % for frequencies within the audio bandwidth.

8.4.2.3 Analogue signals above the audio bandwidth

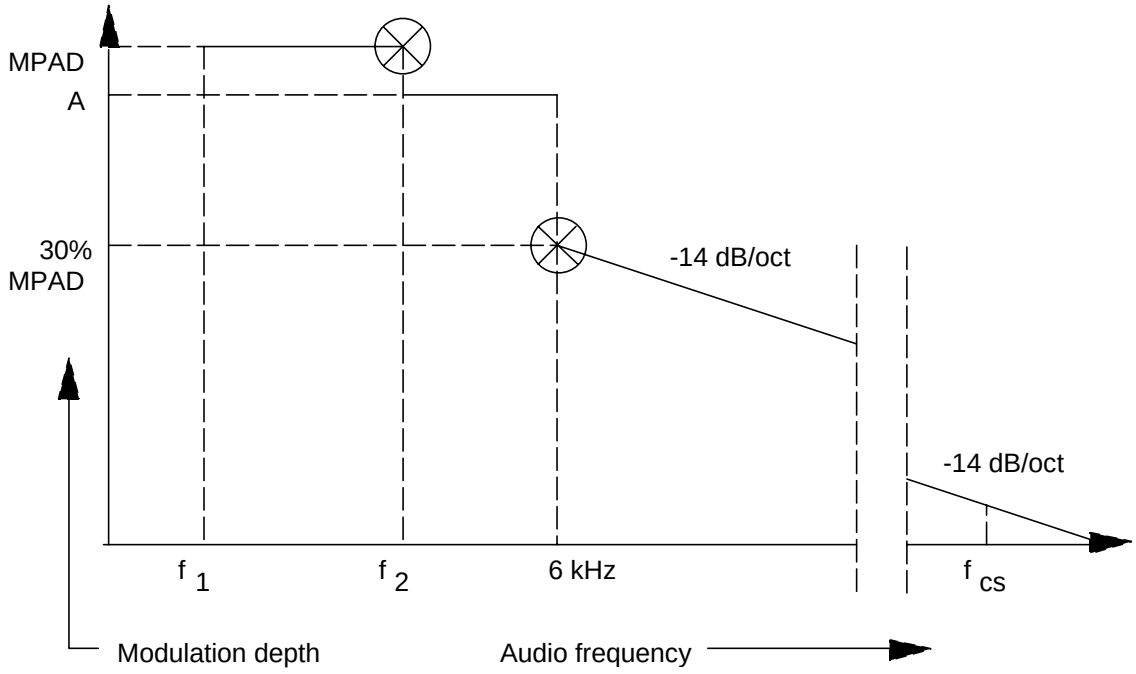
8.4.2.3.1 Method of measurement

The transmitter shall be connected to the artificial antenna (see subclause 6.2). A transmitter without a 50 Ω output connector shall be placed in the test fixture (see subclause 6.3) connected to an artificial antenna. The modulation depth shall be measured by means of a modulation depth meter. The modulation depth meter shall be suitable to cover the required dynamic range.

The modulation frequency shall be varied between 3 kHz for equipment operating with 20 kHz or 25 kHz channel separations, or 2,55 kHz for equipment operating with 10 kHz or 12,5 kHz channel separations and the frequency equal to the channel separation for which the equipment is intended to operate. The level of the test signal shall be the level which produces a modulation depth of 60 %, or any lower value as declared by the applicant using A-M2 (see subclause 6.1.1). The level of the test signal shall then be increased by 20 dB, or 10 dB in the case of a transmitter with integrated microphone. At each test frequency, the resulting modulation depth shall be recorded.

8.4.2.3.2 Limits

The modulation depth at modulation frequencies between the audio bandwidth and 6 kHz shall not exceed the modulation depth measured at the audio bandwidth. At 6 kHz the modulation depth shall be not more than 30 %. The modulation depth at modulation frequencies between 6 kHz and a frequency equal to the channel separation for which the equipment is intended to operate shall not exceed the value given by a linear representation of the modulation depth (dB) relative to the modulation frequency, starting at the 6 kHz limit and having a slope of -14 dB per octave. These limits are illustrated in figure 2.



NOTE:

f_1: 300 Hz
f_2: 3,0 kHz (for 20 kHz or 25 kHz channel separation); or
2,55 kHz (for 10 kHz or 12,5 kHz channel separation)
MPAD: maximum permissible amplitude modulation depth (see subclause 8.4.2.2.2)
A: measured modulation depth at f_2
f_{cs}: frequency equal to channel separation

Figure 2

8.5 Adjacent channel power

These measurements are not applicable for wide band equipment. For wideband equipment, the range of modulation bandwidth shall be measured (see subclause 8.6).

8.5.1 Definition

For devices with specified channel bandwidth, 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.

8.5.2 Method of measurement

8.5.2.1 Method of measurement using a power measuring receiver

The adjacent channel power shall be measured with a power measuring receiver which conforms with the requirements given in annex B.

When using the test fixture (see subclause 6.3) for this measurement, it is important to ensure that direct radiation from the transmitter to the power measuring receiver does not affect the result or the loss introduced by the test fixture.

The following procedure shall be used:

a) the transmitter under test shall be connected via the test load to a power measuring receiver calibrated to measure rms power level. The level at the receiver input shall be within its allowed limit. The transmitter shall be operated at the maximum operational carrier power level under normal conditions;

b) the tuning of the power measuring receiver shall be adjusted away from the carrier so that its -6 dB response nearest to the transmitter carrier frequency is located at a displacement from the nominal frequency of the carrier as given in table 10.

Table 10

Channel separation (kHz)	Displacement (kHz)
10	5,75
12,5	8,25
20	13
25	17

The same result may be obtained by tuning the power measuring receiver (point 0 in figure B.1 of the power measuring filter shape) to the nominal frequency of the adjacent channel, if it has been suitably calibrated.

c) the transmitter shall be modulated as follows:

- equipment for analogue speech and angle modulation shall be modulated with test signal A-M2 (see subclause 6.1.1) at a level 20 dB above the level of the normal test signal, or 10 dB in case of a transmitter with an integrated microphone;
- equipment for analogue speech and amplitude modulation shall be modulated with a test signal A-M2 (see subclause 6.1.1) at a level which is 20 dB higher than the level that is required to produce a modulation depth of 60 %, or 10 dB in case of a transmitter with an integrated microphone;
- equipment using data streams shall be modulated with the test modulation D-M2 (see subclause 6.1.2) at the agreed deviation or modulation depth;
- equipment for messages shall be modulated with the test modulation D-M3 (see subclause 6.1.2) repeated continuously at the agreed deviation or modulation depth.

d) the absolute value of the adjacent channel power shall be recorded;

e) steps b) to d) shall be repeated with the power measuring receiver tuned to the other side of the carrier.

f) The measurement shall be made under normal conditions and, if applicable, under extreme conditions (see clause 8).

8.5.3 Limits

The adjacent channel power shall not exceed the maximum values given in table 11.

Table 11

	Channel separation < 20 kHz	Channel separation ≥ 20 kHz
Normal test conditions	10 µW	200 nW
Extreme test conditions	32 µW	640 nW

8.6 Range of modulation bandwidth for wide band equipment (> 25 kHz)

8.6.1 Definition

The range of modulation bandwidth includes all associated side bands above the appropriate spurious level and the frequency error under extreme test conditions.

Where an assigned frequency band has been subdivided into channels with bandwidths greater than 25 kHz, the 250 nW limit shall apply to the channel edge frequencies.

8.6.2 Method of measurement

In case of equipment with integral antenna, the equipment shall be placed in the test fixture (see subclause 6.3). The RF output of the equipment or the test fixture shall be connected to a spectrum analyser via a 50 Ω connector.

The transmitter shall be operated at the carrier power measured under normal test conditions in subclause 8.2 or 8.3. The attenuator shall be adjusted to an appropriate level displayed on the spectrum analyser screen.

The transmitter shall be modulated by the normal test signal (see subclause 6.1).

The output power of the transmitter, with or without a test fixture, shall be measured using a spectrum analyser resolution bandwidth large enough to accept all major modulation side bands. The power level calibration of the spectrum analyser shall then be related to the power level measured in subclause 8.2 or 8.3. The calculated relation will be used to calculate absolute levels of RF power.

The test laboratory shall ensure that the spectrum analyser's span is sufficiently wide enough to ensure that the emission and all its major modulation side bands are captured. The resolution bandwidth shall be set to 100 Hz and the video bandwidth to 10 kHz.

The spectrum analyser shall be put in "Maximum hold" mode and the measurement shall be made under normal test conditions (see subclause 5.3). The frequencies of the upper and lower points, where the displayed power envelope of modulation equals the appropriate spurious emission level (subclause 8.7.5) is recorded.

The test shall be repeated under extreme test conditions (subclauses 5.4.1 and 5.4.2 applied simultaneously).

The maximum frequency of the upper and the minimum frequency of the lower point, is recorded as the modulation bandwidth.

8.6.3 Limits

The permitted range of modulation bandwidth shall be within the limits of the assigned frequency band.

The maximum frequency error shall not exceed 10 % of the assigne band or wideband channel.

8.7 Spurious emissions

In the case of pulse modulation equipment where it is not possible to make the measurement in the absence of modulation, the measurement shall be carried out by the use of a measuring receiver with bandwidth as stated in subclause 6.6 and quasi-peak detector set in accordance with the specification of CISPR 16 [3] section one for the bands C and D. For measurements above 1 000 MHz the peak value shall be measured using a spectrum analyser.

8.7.1 Definition

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal test modulation. The level of spurious emissions shall be measured as:

a) either:

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

   ii) their effective radiated power when radiated by the cabinet and structure of the equipment (cabinet radiation);

b) or:

   their effective radiated power when radiated by the cabinet and the integral antenna, in the case of portable equipment fitted with such an antenna and no external RF connector.

8.7.2 Method of measuring the power level in a specified load, subclause 8.7.1 a) i)

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

The transmitter shall be connected to a 50 Ω power attenuator. The output of the power attenuator shall be connected to a measuring receiver. The transmitter shall be switched on with modulation, in the case of pulse modulation, and without modulation, for other types of modulation. If an unmodulated carrier cannot be obtained, then the measurements shall be made with the transmitter modulated by the normal test signal D-M3 (see subclause 6.1.2) in which case this fact shall be recorded in the test report.

The measuring receiver, (see subclause 6.6) shall be tuned over the frequency range 9 kHz to 4 GHz for equipment operating on frequencies below 470 MHz, or over the frequency range of 9 kHz to 12,75 GHz for equipment operating on frequencies above 470 MHz. To improve the accuracy of the measurement, a RF preselector may be added in order to avoid harmonic components being introduced by the mixer in the receiver.

At each frequency at which a spurious component is detected, the power level shall be recorded as the conducted spurious emission level delivered into the specified load, except for the channel on which the transmitter is intended to operate and the adjacent channels.

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

8.7.3 Method of measuring the effective radiated power, subclause 8.7.1 a) ii)

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

On a test site, selected from annex A, the equipment shall be placed at the specified height on a non-conducting support and in the position closest to normal use as declared by the applicant.

The transmitter antenna connector shall be connected to an artificial antenna (see subclause 6.2). 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 with modulation, in the case of pulse modulation, and without modulation, for other types of modulation. If an unmodulated carrier cannot be obtained then the measurements shall be made with the transmitter modulated by the normal test signal D-M3 (see subclause 6.1.2) in which case this fact shall be recorded in the test report.

The measuring receiver shall be tuned over the frequency range 25 MHz to 4 GHz, for equipment operating on frequencies below 470 MHz, or over the frequency range of 25 MHz to 12,75 GHz for equipment operating on frequencies above 470 MHz, 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, the test antenna shall be raised and lowered through the specified range of heights until a maximum signal level is detected on the measuring receiver.

The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver and the test antenna height shall be adjusted again for maximum signal level.

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

The transmitter shall be replaced by a substitution antenna as defined in subclauses A.1.2 and A.2.3.

The substitution antenna shall be orientated for vertical polarization and calibrated for the frequency of the spurious component detected.

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

The frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected. The input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary.

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

When a test site according to clause A.3 is used, the height of the antenna need not be varied.

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 any change of input attenuator setting of the measuring receiver.

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

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

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

If applicable, the measurements shall be repeated with the transmitter on standby.

8.7.4 Method of measuring the effective radiated power, subclause 8.7.1 b)

This method applies only to equipment without an external antenna connector. The method of measurement shall be performed according to subclause 8.7.3, except that the transmitter output shall be connected to the integral antenna and not to an artificial antenna.

8.7.5 Limits

The power of any spurious emission, conducted or radiated, shall not exceed the following values given in table 12.

Table 12

State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
Operating	4 nW	250 nW	1 µW
Standby	2 nW	2 nW	20 nW

8.8 Frequency stability under low voltage conditions

This test is for battery operated equipment.

8.8.1 Definition

The frequency stability under low voltage condition is the ability of the equipment to remain on channel, for channelized equipment, or within the assigned operating frequency band, for non-channelized equipment, when the battery voltage falls below the lower extreme voltage level.

8.8.2 Method of measurement

The carrier frequency shall be measured, where possible in the absence of modulation, with the transmitter connected to an artificial antenna. A transmitter without a 50 Ω output connector may be placed in a test fixture (see subclause 6.3) connected to an artificial antenna. The measurement shall be made under normal temperature and humidity conditions (see subclause 5.3.1), the voltage from the test power source shall be reduced below the lower extreme test voltage limit towards zero. Whilst the voltage is reduced the carrier frequency shall be monitored.

8.8.3 Limits

The equipment shall either:

a) remain on the operating frequency, within the limits stated in subclause 8.1.3 whilst the radiated or conducted power is greater than the spurious emission limits; or

b) the equipment ceases to function below the applicants declared operating voltage.

8.9 Duty Cycle

8.9.1 Definitions

For the purpose of the present document the term duty cycle refers to the ratio of the total on time of the "message" to the total off time in any one hour period. The device may be triggered either automatically or manually and depending on how the device is trigged will also depend on whether the duty cycle is fixed or random.

For software controlled or pre-programmed devices, the applicant shall declare the duty cycle class or classes for the equipment under test.

For manually operated or event dependant devices, the applicant shall declare whether the device once triggered, follows a pre-programmed cycle, or whether the transmission is constant until the trigger is released or manually reset. The applicant shall also give a description of the application for the device and include a typical usage pattern. In the case of manual operated devices, the typical usage pattern as declared by the applicant shall be used to determine the duty cycle and hence the duty class.

For software controlled or pre-programmed devices the duty cycle classes are given in table 13.

8.9.2 Duty cycle classes

In a period of 1 hour the duty cycle shall not exceed the values given in table 13.

Table 13

Class	Duty cycle ratio
1	< 0,1 %
2	< 1,0 %
3	< 10 %
4	Up to 100 %

9 Methods of measurement and limits for receiver parameters

9.1 Spurious radiation

9.1.1 Definition

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

The level of spurious radiations shall be measured by:

a) either:

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

ii) their effective radiated power when radiated by the cabinet and structure of the equipment (cabinet radiation);

b) or:

their effective radiated power when radiated by the cabinet and the integral antenna, in the case of portable equipment fitted with such an antenna and no external RF connector.

9.1.2 Method of measuring the power level in a specified load, subclause 9.1.1 a) i)

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

The receiver shall be connected to a 50 Ω attenuator.

The output of the attenuator shall be connected to a measuring receiver. The receiver shall be switched on, and the measuring receiver shall be tuned over the frequency range 9 kHz to 4 GHz for equipment operating on frequencies below 470 MHz, or over the frequency range of 9 kHz to 12,75 GHz for equipment operating on frequencies above 470 MHz.

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

9.1.3 Method of measuring the effective radiated power, subclause 9.1.1 a) ii)

This method applies only to equipment with an external antenna socket.

On a test site, selected from annex A, the equipment shall be placed at the specified height on a non-conducting support and in the position closest to normal use as declared by the applicant. The receiver antenna connector shall be connected to an artificial antenna (see subclause 6.2).

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 and the measuring receiver shall be tuned over the frequency range 25 MHz to 4 GHz, for equipment operating on frequencies below 470 MHz, or over the frequency range 25 MHz to 12,75 GHz for equipment operating on frequencies above 470 MHz. At each frequency at which a spurious component is detected, the test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver. When a test site according to clause A.3 is used, there is no need to vary the height of the antenna.

The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver and the test antenna height shall be adjusted again for maximum signal level.

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

The receiver shall be replaced by a substitution antenna as defined in subclauses A.1.3 and A.2.3.

The substitution antenna shall be orientated for vertical polarization and calibrated for the frequency of the spurious component detected.

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

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

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

The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the spurious component was measured, corrected for any change of input attenuator setting of the measuring receiver. The input level to the substitution antenna shall be recorded as power level, corrected for any change of input attenuator setting of the measuring receiver.

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

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

9.1.4 Method of measuring the effective radiated power, subclause 9.1.1 b)

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

The method of measurement shall be performed according to subclause 9.1.3, except that the receiver input shall be connected to the integral antenna and not to an artificial antenna.

9.1.5 Limits

The power of any spurious emission, radiated or conducted, shall not exceed the values given below:

- 2 nW below 1 000 MHz;
- 20 nW above 1 000 MHz.

9.2 Spurious response rejection and blocking/desensitization

For efficient use of the spectrum, there are no requirements.

9.2.1 Method of measurement

For the purposes of electromagnetic compatibility, the following method of measurement shall be used:

- subclause 9.9 of ETS 300 113 [5]; or
- subclause 9.7 of ETS 300 390 [6];

except that the level of signal generator B shall be set to a level 84 dB above the level of signal generator A, and shall not be adjusted during the test.

9.2.2 Preformance criteria for electromagnetic compatibility

For transmitters, the general performance criteria (subclause 6.4, ETS 300 683 [7]) shall apply.

For receivers, the general performance criteria (subclause 6.6, ETS 300 683 [7]) shall apply.

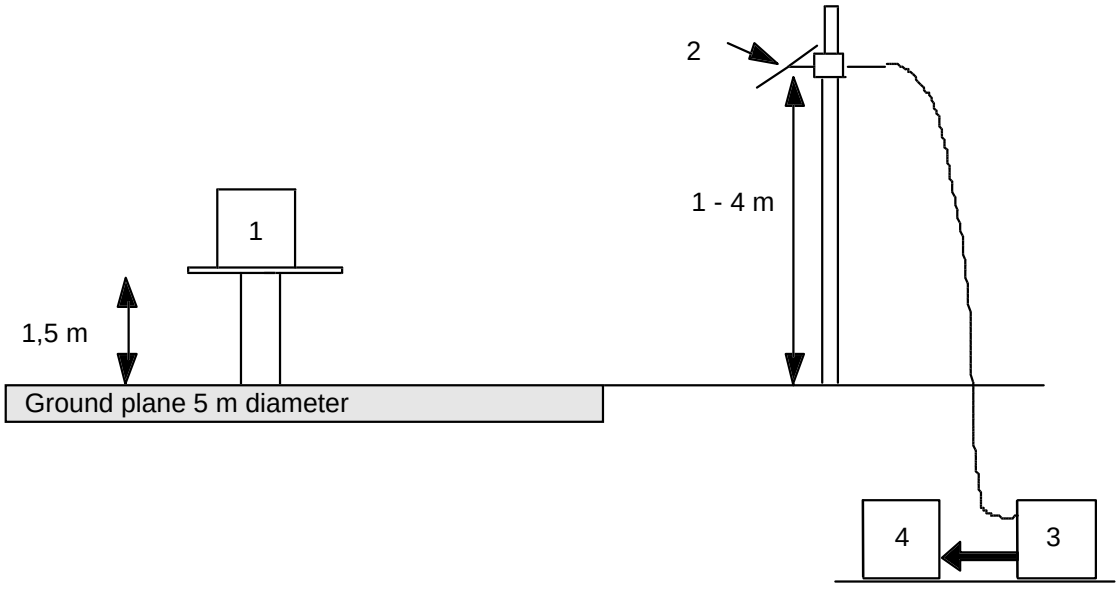
Annex A (normative): Radiated measurements

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

A.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 in its standard position, 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 $\lambda/2$ 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 do not degrade the measurements results.



NOTE:

1) Equipment under test
2) Test antenna
3) High pass filter (may not be necessary)
4) Spectrum analyser or measuring receiver

Figure A.1

A.1.1.1 Standard position

The standard position in all test sites, except for equipment which is intended to be worn on a person or handheld, shall be as follows:

- for equipment with an integral antenna or dedicated antenna, it shall be placed in the position closest to normal use as declared by the applicant;
- for equipment with a rigid external antenna, the antenna shall be vertical;
- for equipment with non-rigid external antenna, the antenna shall be extended vertically upwards by a non-conducting support.

For equipment intended to be worn close to the body or handheld, the non-conducting support may, at the request of the applicant, be replaced with the simulated man, if appropriate. The use of the simulated man shall be stated in the test report.

The simulated man shall consist of an acrylic tube, filled with salt water (1,5 grams NaCl per litre of distilled water). The tube shall have a length of 1,7 ± 0,1 m and an internal diameter of 300 ± 5 mm with sidewall thickness of 0,5 ± 0,5 mm.

To reduce the weight of the simulated man it may be possible to use an alternative tube which has a hollow centre of 200 mm maximum diameter.

The sample shall be fixed to the surface of the simulated man, at the appropriate height for the equipment.

A.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.

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.

A.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 operating frequency, 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 not be less than 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 operate 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.

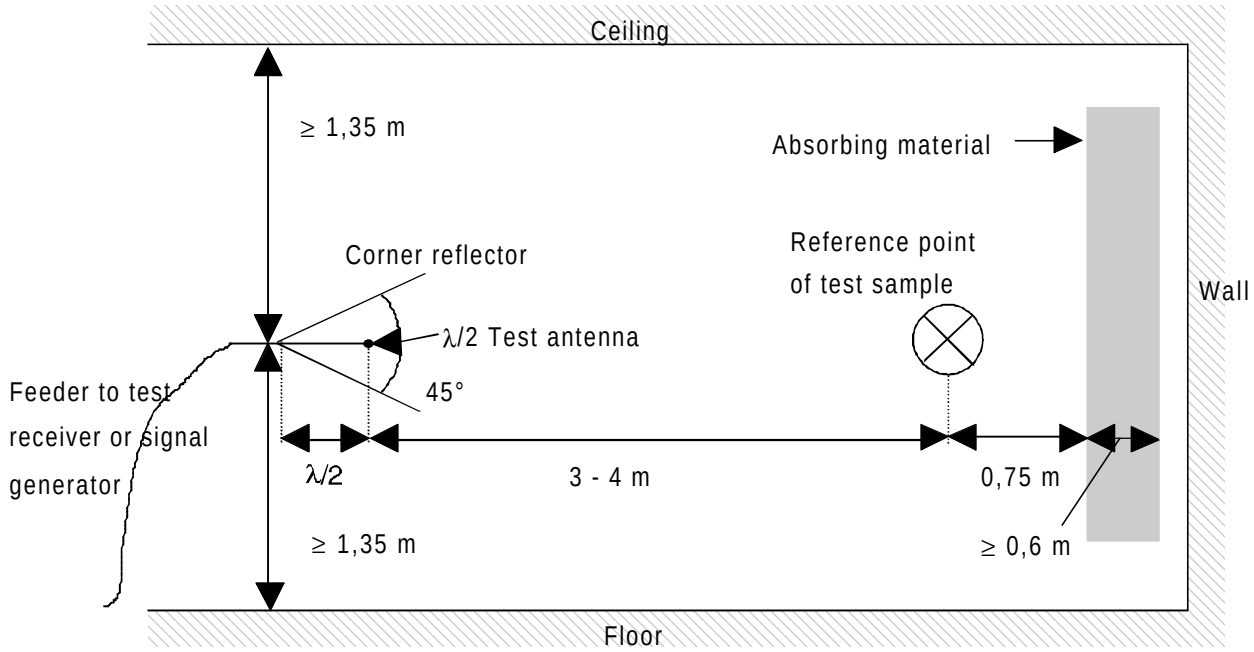


Figure A.2: Indoor site arrangement (shown for horizontal polarization)

A.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 test 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 A.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 the 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.

A.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 A.1 of this annex. When using such a test site, the following conditions should be observed to ensure consistency of measuring results.

A.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 that 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.

A.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 approximately 100 MHz.

A.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 approximately 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 test site. Correction factors shall be taken into account when shortened dipole antennas are used.

A.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.

A.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 measurement 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).

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

For radiation measurements, when test frequency of the signals being measured is greater than 30 MHz, use may be made of an indoor test site being a well-shielded anechoic chamber simulating a 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 A.1. In the range 25 MHz to 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.

A.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 A.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 more suitable for measurements above 100 MHz. Figure A.4 shows the construction of an anechoic 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 RF absorbers approximately 1 m high. The base is covered with absorbers which form a non-conducting sub-floor, or with special ground floor absorbers. The available internal dimensions of the room are 3 m × 8 m × 3 m, so that a maximum measuring distance of 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 2λ.

The floor absorbers reduce 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 measurement uncertainties have the smallest possible values due to the simple measuring configuration.

A.3.2 Influence of parasitic reflections in anechoic chambers

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

It is useful to use 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 A.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 GHz to 12,75 GHz, because more reflections will occur, the dependence of the field strength on the distance will not correlate so closely.

A.3.3 Calibration of the shielded RF anechoic chamber

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

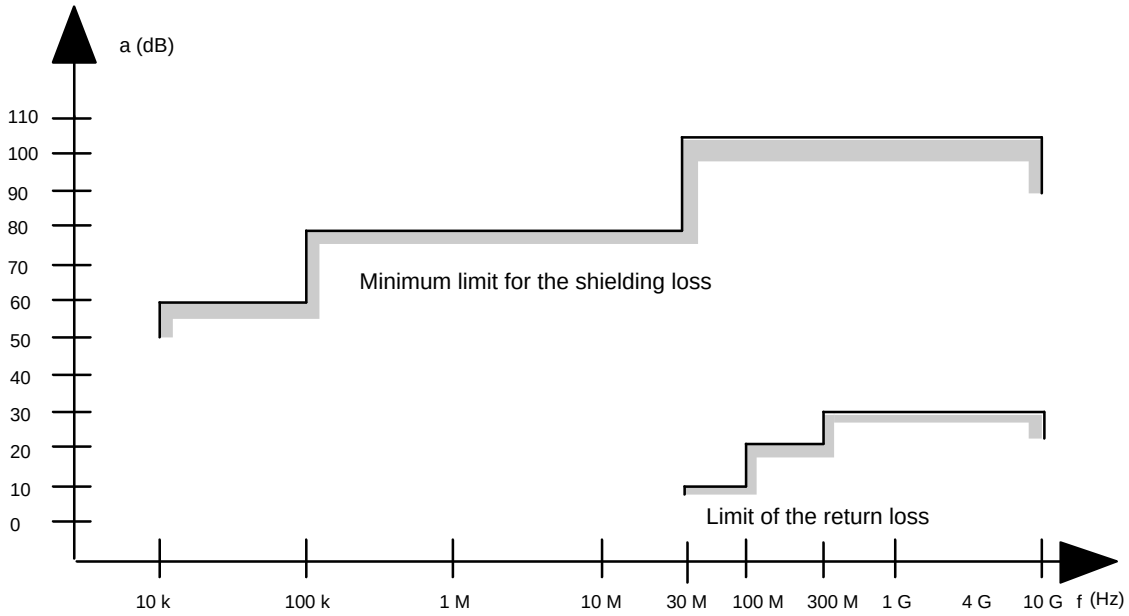
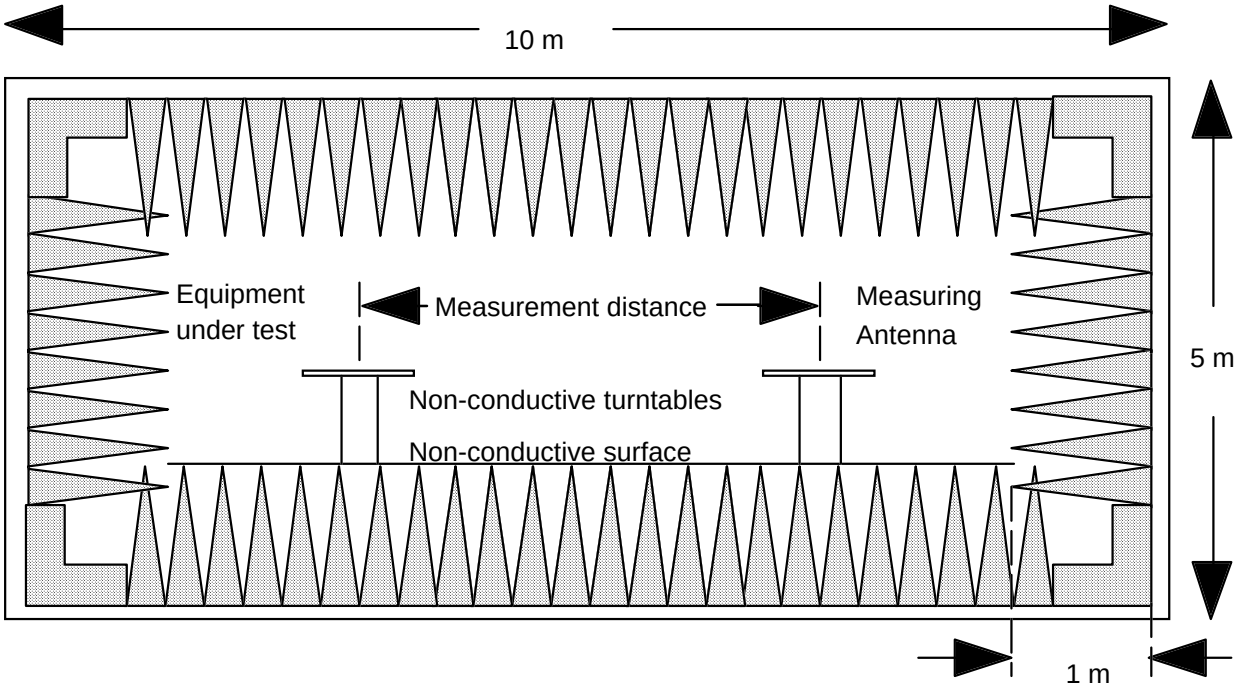


Figure A.3: Specification for shielding and reflections



Ground plan

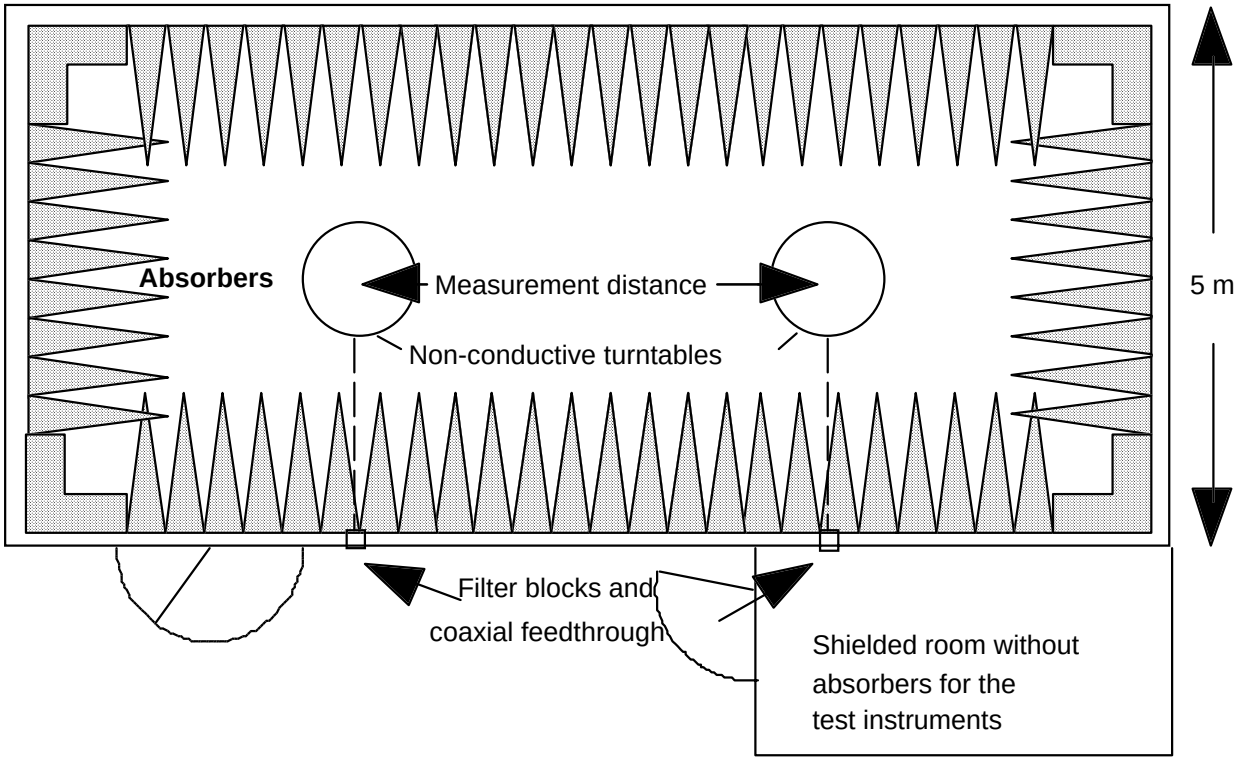


Figure A.4: Example of construction of an anechoic shielded chamber

Annex B (normative): Specifications for adjacent channel power measurement arrangements

B.1 Power measuring receiver specification

The power measuring receiver consists of a mixer, an Intermediate Frequency (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 as the rms value indicator. The technical characteristics of the power measuring receiver are given in subclauses B.1.1 to B.1.4.

B.1.1 IF filter

The IF filter shall be within the limits of the selectivity characteristic of figure B.1.

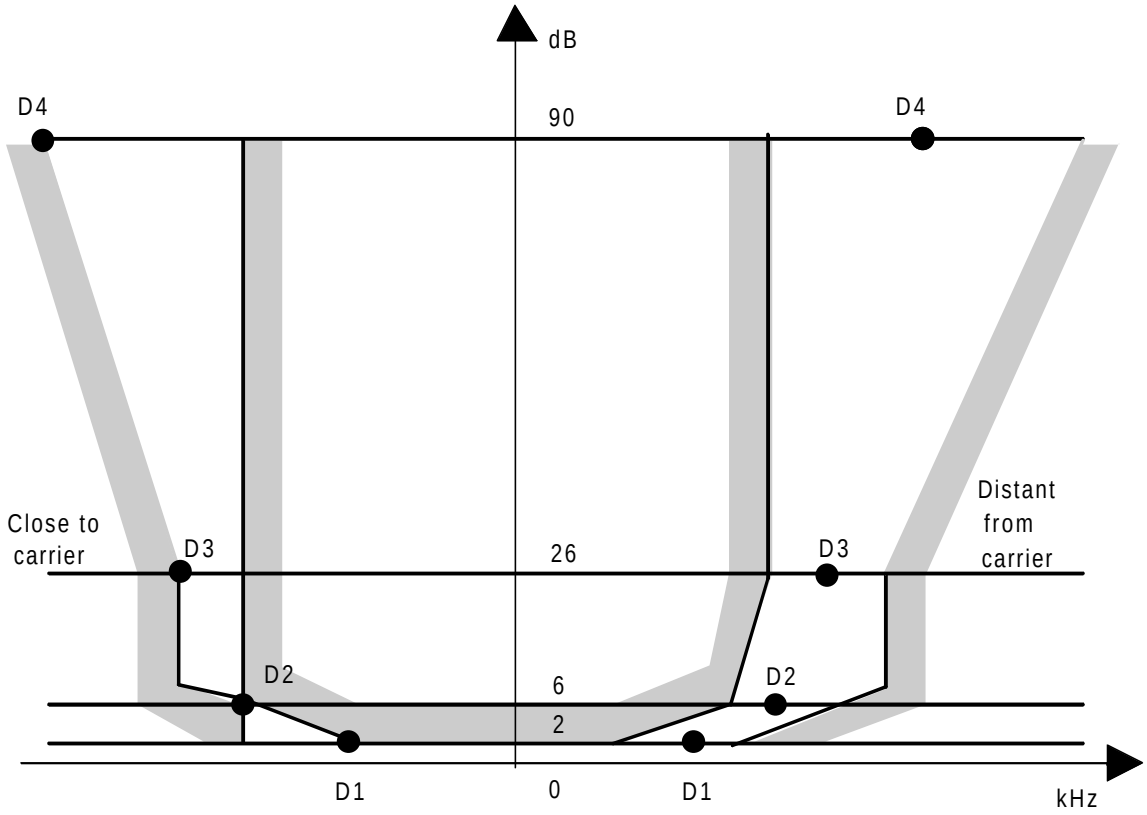


Figure B.1

Depending on the channel separation, the selectivity characteristic shall keep the following frequency separations from the nominal centre frequency of the adjacent channel.

Table B.1: Selectivity characteristic

Channel separation (kHz)	Frequency separation of filter curve from nominal centre frequency of adjacent channel (kHz)			
	D1	D2	D3	D4
10/12,5	3,0	4,25	5,5	9,5
20	4,0	7,0	8,25	12,25
25	5,0	8,0	9,25	13,25

Depending on the channel separation, the attenuation points shall not exceed the tolerances given in tables B.2 and B.3.

Table B.2: Attenuation points close to carrier

Channel separation (kHz)	Tolerance range (kHz)			
	D1	D2	D3	D4
10/12,5	+1,35	±0,1	-1,35	-5,35
20	+3,1	±0,1	-1,35	-5,35
25	+3,1	±0,1	-1,35	-5,35

Table B.3: Attenuation points distant from the carrier

Channel separation (kHz)	Tolerance range (kHz)			
	D1	D2	D3	D4
10/12,5	±2,0	±2,0	±2,0	+2,0 -6,0
20	±3,0	±3,0	±3,0	+3,0 -7,0
25	±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 Variable attenuator

The variable attenuator shall have a minimum range of 80 dB and a resolution of 1 dB.

B.1.3 Rms value indicator

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

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 ≤ -90 dB for channel separations of 20 kHz and 25 kHz, and of ≤ -80 dB for a channel separation of 10 kHz and 12,5 kHz, referred to the carrier of the oscillator.

Annex C (normative): Technical performance of the spectrum analyser

The specification shall include the following requirements:

It shall be possible, using a resolution bandwidth of 1 kHz, to measure the amplitude of a signal or noise at a level 3 dB or more above the noise level of the spectrum analyser as displayed on the screen, to an accuracy of ±2 dB in the presence of a signal separated in frequency by:

a) 10 kHz, at a level 90 dB above that of the signal to be measured for 25 kHz and 20 kHz channel separations; and

b) 6,25 kHz, at a level 80 dB above that of the signal to be measured for a 12,5 kHz channel separation; and

c) 5 kHz at a level 80 dB above that of the signal to be measured for a 10 kHz channel separation.

The reading accuracy of the frequency marker shall be within ±2 % of the channel separation.

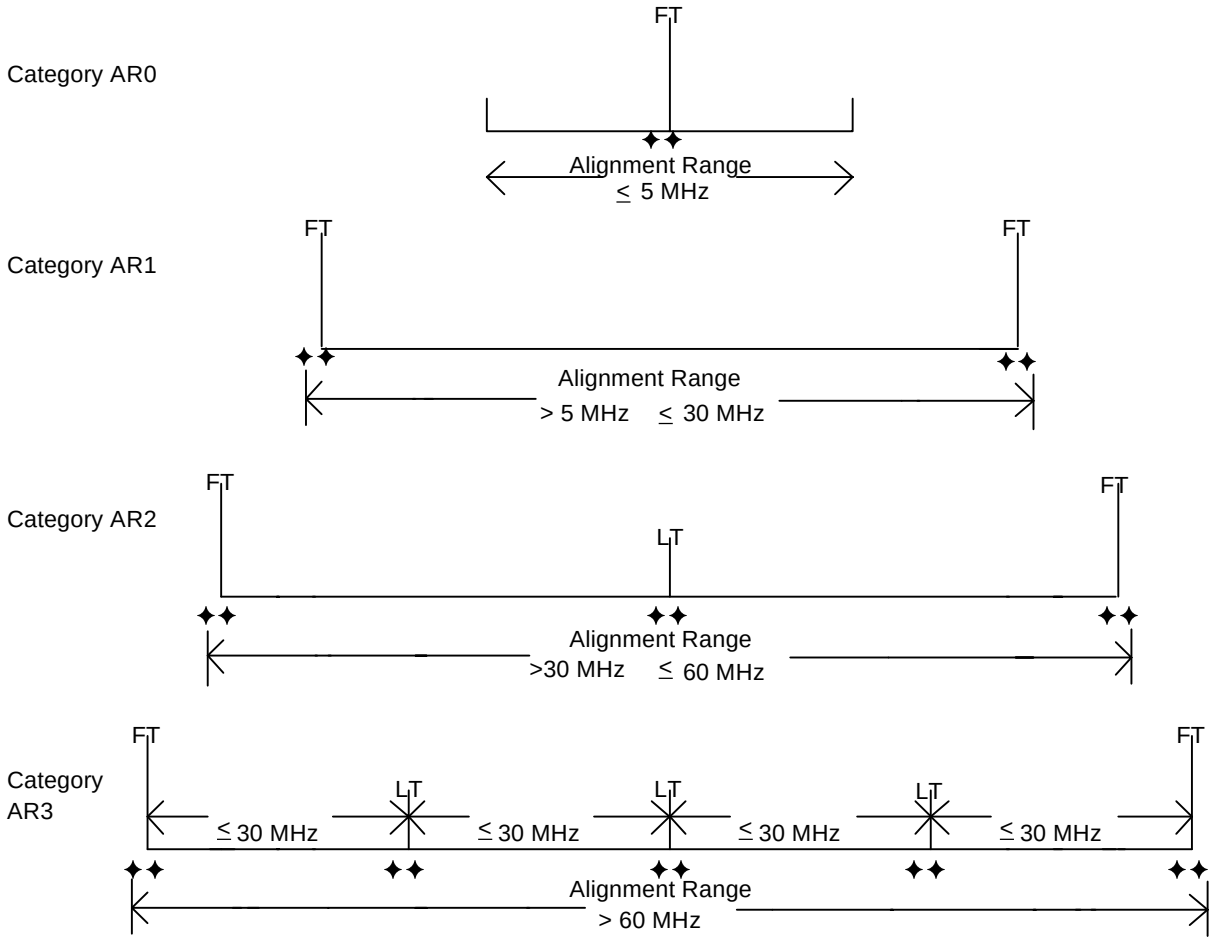
The accuracy of relative amplitude measurements shall be within ±1 dB.

It shall be possible to adjust the spectrum analyser to allow the separation, on the display, of two components with a frequency difference of 1 kHz.

Annex D (normative): Graphic representation of the selection of equipment and frequencies for testing

D.1 Tests on a single sample

If the operating frequency range of each equipment corresponds to its alignment range (AR0, AR1, AR2, or AR3), then only one sample shall be tested.



Legend:

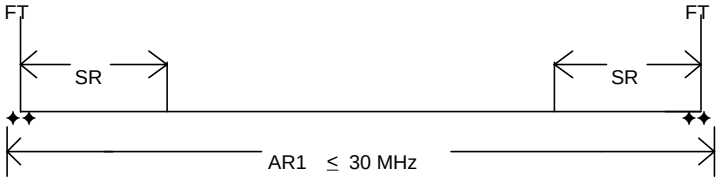
AR0	First category of alignment range, see subclause 4.1.3
AR1	Second category of alignment range, see subclause 4.1.3
AR2	Third category of alignment range, see subclause 4.1.3
AR3	Fourth category of alignment range, see subclause 4.1.3
LT	Limited tests, see subclause 3.1
FT	Full tests, see subclause 3.1
✦✦	50 kHz range in which tests are carried out

Figure D.1: Tests on a single sample for equipment that has a SR equal to its alignment range

D.2 Tests and samples needed when the switching range is a subset of the alignment range

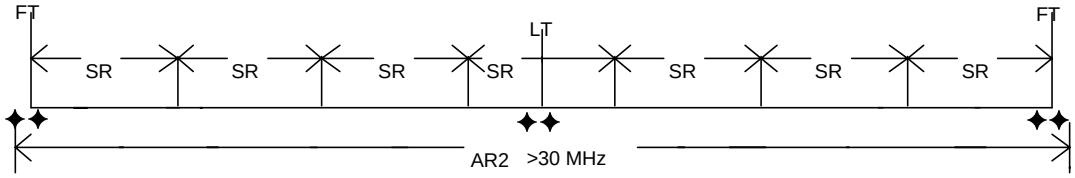
In order to cover an alignment range several separate samples, having different SRs within the alignment range, may be needed. Samples shall be then provided for testing in accordance with subclauses 4.1.4, 4.1.5, 4.1.6, and 4.1.7, as appropriate. The following examples assume a SR of 5 MHz.

Category AR1



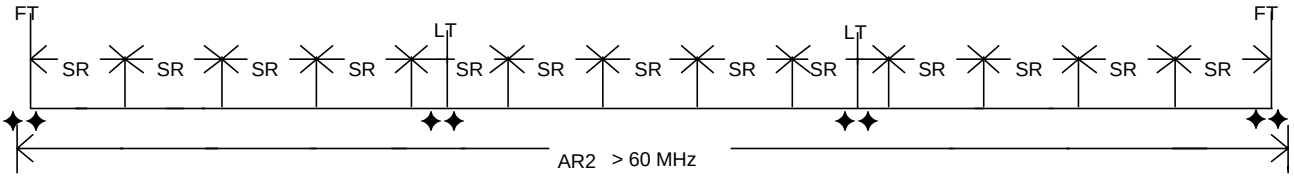
2 Samples, 2 FT

Category AR2



3 Samples, 2 FT, 1 LT.

Category AR3



4 Samples, 2 FT, 2 LT.

Legend:

SR	Switching Range, see subclause 4.1.2
AR1	Second category of alignment range, see subclause 4.1.3
AR2	Third category of alignment range, see subclause 4.1.3
AR3	Fourth category of alignment range, see subclause 4.1.3
LT	Limited tests, see subclause 3.1
FT	Full tests, see subclause 3.1
✦✦	50 kHz range in which tests are carried out

Figure D.2: Tests on equipment having switching ranges that are subsets of their alignment range

D.3 Tests and samples for a family of equipment where the alignment range is a subset of the total operating frequency range

If the alignment range of a piece of equipment is a subset of the total operating frequency range, then the operating frequency range shall be divided into appropriate categories of alignment range. Samples shall be then provided for testing in accordance with subclauses 4.1.4, 4.1.5, 4.1.6, and 4.1.7, as appropriate.

For example, the applicant seeks type approval for a family of equipment having an operating frequency range of 403 MHz to 470 MHz. The equipment to be tested does not cover this range with one category of alignment range.

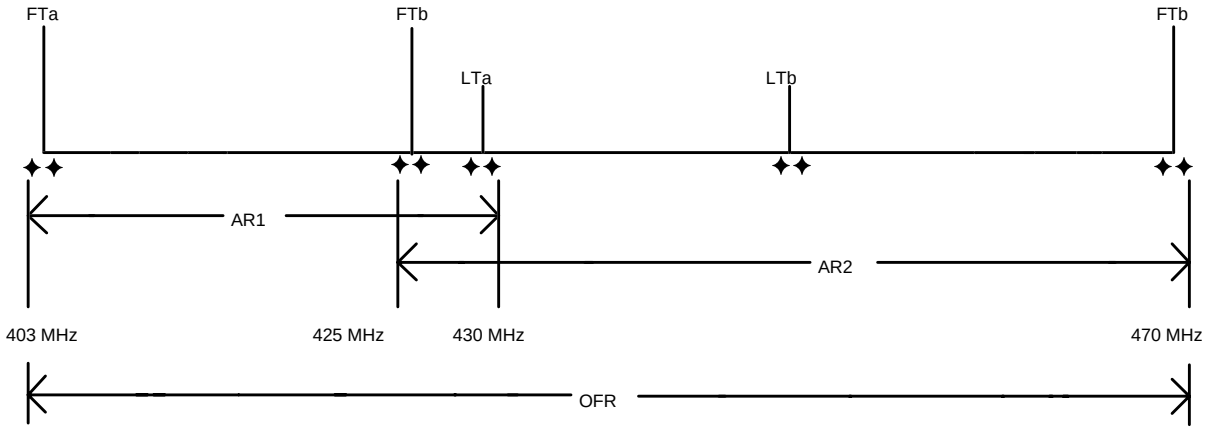
D.3.1 Test scenario 1

The OFR could be covered by two alignment ranges a) and b).

a) 403 MHz to 430 MHz: this is category AR1;

b) 425 MHz to 470 MHz: this is category AR2.

This example requires a minimum of two test samples and a maximum of five test samples to cover the operating frequency range.



Legend:

OFR	Operational frequency range, see subclause 4.1.2
AR1	Second category of alignment range, see subclause 4.1.3
AR2	Third category of alignment range, see subclause 4.1.3
AR3	Fourth category of alignment range, see subclause 4.1.3
Fta	Full tests on sample(s) a). See subclause 3.1
Lta	Limited tests on sample(s) a). See subclause 3.1
FTb	Full tests on sample(s) b)
LTb	Limited test on sample(s) a)
✦✦	50 kHz range in which tests are carried out

Figure D.3: Tests on family member equipment having alignment ranges that are subsets of the total operating frequency range. Example 1

D.3.2 Test scenario 2

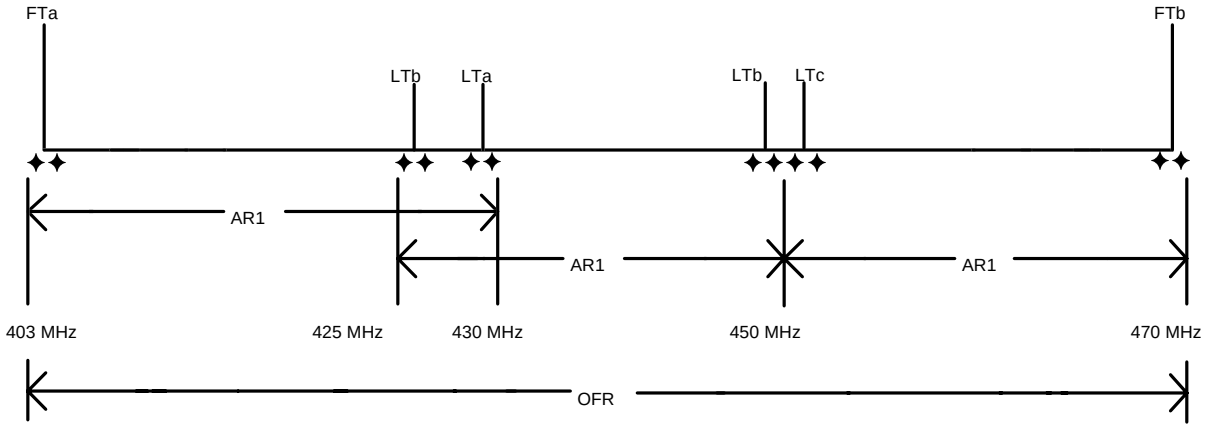
The OFR could alternatively be covered by three alignment ranges of category AR1:

a) 403 MHz to 430 MHz: this is category AR1;

b) 425 MHz to 450 MHz: this is category AR1;

c) 450 MHz to 470 MHz: this is category AR1.

This example requires a minimum of three test samples and a maximum of six test samples to cover the operating frequency range.



Legend:

OFR	Operational frequency range, see subclause 4.1.2
AR1	Second category of alignment range, see subclause 4.1.3
AR2	Third category of alignment range, see subclause 4.1.3
AR3	Fourth category of alignment range, see subclause 4.1.3
Fta	Full tests on sample(s) a). See subclause 3.1
Lta	Limited tests on sample(s) a). See subclause 3.1
LTb	Limited test on sample(s) a)
FTc	Full tests on sample(s) c)
LTc	Limited tests on sample(s) c)
✦✦	50 kHz range in which tests are carried out

Figure D.4: Tests on family member equipment having alignment ranges that are subsets of the total operating frequency range. Example 2

Annex E (normative): Subclauses of this EN relevant for compliance with the essential requirements of relevant EC Council Directives

Table E.1: Subclauses of this EN relevant for compliance with the essential requirements of relevant EC Council Directives

Clause/subclause number and title		Corresponding article of Council Directive 89/336/EEC	Qualifying remarks
8.7	Spurious emissions	4(a)	for transmitters and transceivers
9.1	Spurious radiations	4(a)	for receivers only
9.2	Spurious response rejection and blocking/desensitization	4(b)	for receivers only

History

Document history				
Edition 1	October 1993	Publication as ETS 300 220-1		
Edition 2	December 1996	Public Enquiry	PE 120:	1996-12-16 to 1997-04-11
V1.2.1	August 1997	Vote	V 9742:	1997-08-19 to 1997-10-17