Draft ETSI EN 300 341 V2.1.0 (2015-12)

HARMONISED EUROPEAN STANDARD

Land Mobile Service; Radio equipment using an integral antenna transmitting signals to initiate a specific response in the receiver; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

Reference

REN/ERM-TGDMR-352

Keywords

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Contents

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Foreword

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

The present document has been prepared in reply to the Commission's standardisation request Commission Implementing Decision C(2015) 5376 final of 04.08.2015 to provide a means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment.

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table C.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

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

Modal verbs terminology

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

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

1 Scope

The present document applies to constant envelope angle modulation systems for use in the land mobile service, using the available bandwidth, operating on radio frequencies between 30 MHz and 1 GHz, with channel separations of 12,5 kHz, 20 kHz and 25 kHz intended for transmission and/or reception of signals used to initiate a specific response in the receiver.

Table 1: Radiocommunications service frequency bands

	Radiocommunications service frequency bands
Transmit	30 MHz to 1 000 MHz
Receive	30 MHz to 1 000 MHz

The present document applies to non-speech and to the non-speech part of combined speech/non-speech analogue equipment. In the present document, non-speech radio equipment is defined as a radio equipment transmitting a signal to initiate a specific response in the receiver. The equipment comprises a transmitter and associated encoder and/or a receiver and associated decoder. The encoder and/or decoder may be a separate piece of equipment, in which case compliance to the present document covers the encoder and/or decoder in connection with the transmitter and/or receiver equipment.

In the present document different requirements are given for the different radio frequency bands, channel separations, environmental conditions and types of equipment, where appropriate.

The type of equipment covered by the present document is handportable stations with integral antennas.

The present document contains requirements to demonstrate that "*... Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference*" and that *"....radio equipment supports certain features ensuring access to emergency services"* [i.5].

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the Radio Equipment Directive [i.5] may apply to equipment within the scope of the present document.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

[1] ETSI TR 100 028 (V1.4.1) (12-2001) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[2] ANSI C63.5 (2006): "American National Standard for Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas (9 kHz to 40 GHz)".

[3] ETSI EN 300 296 (V2.1.0) (12-2015): "Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[4] ETSI TR 100 028-2 (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 300 793 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Presentation of equipment for type testing".

[i.2] ETSI TR 102 273 (V1.2.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".

[i.3] IEC 60489-3 (1988): "Methods of measurement for radio equipment used in the mobile services; Part 3: Receivers for A3E or F3E emissions".

[i.4] CEPT/ERC/REC 74-01E: "Unwanted emissions in the spurious domain" (Siófok 1998, Nice 1999, Sesimbra 2002; Hradec Kralove 2005).

[i.5] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

[i.6] Commission Implementing Decision C(2015) 5376 final of 04.08.2015: Commission Implementing Decision on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

angle modulation: either phase modulation (G3) or frequency modulation (F3)

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

handportable station: equipment either fitted with an antenna socket or an integral antenna, or both, normally used on a stand-alone basis, to be carried on a person or held in the hand

integral antenna: antenna designed to be connected to the equipment without the use of a 50 Ω external connector and considered to be part of the equipment

NOTE: An integral antenna may be fitted internally or externally to the equipment.

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

3.2 Symbols

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

r.m.s root mean square

3.3 Abbreviations

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

AF	Audio Frequency
BER	Bit Error Rate
CSP	Channel Spacing
CW	Continuous Wave
dBc	dB relative to the carrier power
emf	electro-motive force
EUT	Equipment Under Test
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
OATS	Open Area Test Site
RBW	Resolution BandWidth
RF	Radio Frequency
Rx	Receiver
SINAD	Signal, Noise And Distortion (to noise and distortion ratio)
Tx	Transmitter
VSWR	Voltage Standing Wave Ratio

4 Speech equipment with signalling

4.1 Applicability

4.1.1 General

Where several harmonised standards are applicable to the equipment then the following shall be followed to avoid double testing of the same parameters.

4.1.2 Equipment with speech and signalling functions

In the case of combined speech/non-speech equipment the speech part shall be tested to ETSI EN 300 296 [3] and additionally the tests described in the following clauses of the present document shall be carried out:

clause 8.3: Adjacent channel power;

clause 9.1: Average usable sensitivity (responses, field strength) in the case of equipment having an integral antenna.

These requirements also apply for equipment with an analogue output facility provided for test purposes only.

Additionally, the measurement of the spurious emissions (clause 8.5) shall be performed when an equipment, previously tested to ETSI EN 300 296 [3] is being tested to the present document with an add-on signalling unit. If the equipment has been originally combined for analogue and signalling operation, the measurement of the spurious emissions need not to be performed again if the signalling port(s) (and the signalling circuits/modules) were active while making this measurement for the test ETSI EN 300 296 [3].

4.1.3 Equipment with an add-on signalling unit

In the case where an equipment has already been tested according to the present document and is re-tested with an add-on-signalling unit using another type of modulation without affecting any other characteristic of the equipment, only some additional measurements shall be performed; they shall ensure that the equipment fulfils the requirements of the following clauses:

clause 8.3: adjacent channel power;

clause 8.4: radiated spurious emissions;

clause 9.1: average usable sensitivity (responses, field strength).

In the case where signalling is transmitted simultaneously with analogue speech, the speech part of the equipment is tested according to ETSI EN 300 296 [3] , and it shall also be checked that the signalling does not cause the adjacent channel power and spurious emissions to exceed the appropriate limits.

5 General and operational requirements

5.1 General

5.1.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the supplier, but as a minimum, shall be that specified in the test conditions contained in the present document.

5.1.2 Choice of model for testing

All necessary setting up instructions and other product information shall be made available with the equipment to be tested, in accordance with article 10.8 of Directive 2014/53/EU [i.5].

NOTE: Guidance on the presentation of equipment is also given in ETSI EN 300 793 [i.1].

5.2 Mechanical and electrical design

5.2.1 General

Equipment shall be designed, constructed and manufactured in accordance with sound engineering practice, and with the aim of minimizing harmful interference to other equipment and services.

5.2.2 Controls

Those controls which if maladjusted might increase the interfering potentialities of the equipment shall not be accessible to the user.

5.2.3 Transmitter shut-off facility (time-out)

When a timer for an automatic shut-off facility is operative, at the moment of the time-out the transmitter shall automatically be switched off. (The activation of the transmitter key shall reset the timer). A shut off facility shall be inoperative for the duration of the measurements unless it has to remain operative to protect the equipment.

5.3 Marking

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

6 Test conditions, power sources and ambient temperatures

6.1 Normal and extreme test conditions

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

6.2 Test power source

During type tests the power source of the equipment shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in clauses 6.3.2 and 6.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

If the equipment is provided with a permanently connected power cable, the test voltage shall be that measured at the point of connection of the power cable to the equipment.

For battery operated equipment the battery shall be removed and the test power source shall be applied as close to the battery terminals as practicable.

During tests the power source voltages shall be maintained within a tolerance of < ±1 % relative to the voltage at the beginning of each test. The value of this tolerance is critical to power measurements, using a smaller tolerance will provide better measurement uncertainty values.

6.3 Normal test conditions

6.3.1 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 the 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.

6.3.2 Normal test power source

6.3.2.1 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 and 51 Hz.

6.3.2.2 Regulated lead-acid battery power sources used on vehicles

When the radio equipment is intended for operation from the usual types of regulated lead-acid battery power source used on vehicles, the normal test voltage shall be 1,1 times the nominal voltage of the battery (for nominal voltages of 6 V and 12 V, these are 6,6 V and 13,2 V respectively).

6.3.2.3 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 manufacturer.

6.4 Extreme test conditions

6.4.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in clause 6.5, at the upper and lower temperatures of the following range:

- -20° C to +55° C

For the purpose of clause 7.1.3 (a) an additional extreme temperature range of 0° C to +30° C shall be used.

Type test reports shall state the temperature range used.

6.4.2 Extreme test source voltages

6.4.2.1 Mains voltage

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

6.4.2.2 Regulated lead-acid battery power sources used on vehicles

When the equipment is intended for operation from the usual types of regulated lead-acid battery power sources used on vehicles the extreme test voltages shall be 1,3 and 0,9 times the nominal voltage of the battery (for a nominal voltage of 6 V, these are 7,8 V and 5,4 V respectively and for a nominal voltage of 12 V, these are 15,6 V and 10,8 V respectively).

6.4.2.3 Power sources using other types of batteries

The lower extreme test voltages for equipment with power sources using the following batteries shall be:

- for the Leclanché or the lithium type of battery: 0,85 times the nominal voltage of the battery;
- for the mercury or nickel-cadmium type of battery: 0,9 times the nominal voltage of the battery.

No upper extreme test voltages apply.

6.4.2.4 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 manufacturer and the testing laboratory and shall be recorded in the test report.

6.5 Procedure for tests at extreme temperatures

6.5.0 Thermal Balance

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 may be switched on for 15 minutes after thermal balance has been obtained, and the equipment shall then meet the specified requirements. For such equipment the manufacturer shall provide for the power source circuit feeding the crystal oven to be independent of the power source to the rest of the equipment.

If the thermal balance is not checked by measurements, a temperature-stabilizing period of at least one hour, or a longer period of time as may be decided by the testing 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.

6.5.1 Procedure for equipment designed for continuous operation

If the manufacturer 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 conditions 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 standby or receive condition for a period of one minute after which the equipment shall meet the specified requirements.

6.5.2 Procedure for equipment designed for intermittent operation

If the manufacturer 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. The equipment shall then be switched on for one minute in the transmit condition, followed by four minutes in the receive condition, 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.

7 General conditions of measurement

7.1 Normal test signals, test conditions and the unwanted test signals

The normal test signal D-M3 for initiating responses shall be trains of correctly coded bits or correctly coded signals (messages), if possible of length 22 bits. For sequential tone coded information, each information (e.g. selective call) shall not be longer than about 400 ms. These test signals D-M3 shall be separated from each other by a time of not less than the reset time of the receiver.

For measurements using the up-down method it shall be possible to trigger single test signals D-M3 either manually or by an automatic testing system.

The test signal D-M4 consists of coded signals, messages or tones transmitted sequentially, one by one, without gaps between them. This transmission is necessary for measurements such as adjacent channel power (see clause 8.3), spurious emissions (see clause 8.4), radiated emissions and others.

All these signals shall be defined such that they require the greatest occupied radio modulation bandwidth. Details of these test signals and the test modulation shall be included in the test report.

The unwanted signal A-M3 is a RF signal modulated with a continuous 400 Hz tone and with a deviation of 12 % of the channel separation. It is used for measurements such as co-channel rejection (see clause 9.2), adjacent channel selectivity (see clause 9.3) and others.

7.2 Artificial antenna

Tests on the transmitter requiring the use of the test fixture shall be carried out with a substantially non-reactive non-radiating load of 50 Ω connected to the test fixture terminal.

7.3 Test sites and general arrangements for radiated measurements

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

7.4 Transmitter automatic shut-off facility

If the equipment is fitted with an automatic transmitter shut-off facility it shall be made inoperative for the duration of the type test unless it has to be left operative to protect the equipment. If the shut off facility is left operative the status of the equipment shall be indicated.

7.5 Modes of operation of the transmitter

For the purpose of the measurements according to the present document, there shall preferably 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 manufacturer and the test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test.

7.6 Arrangements for test signals at the input of the receiver via a test fixture or a test antenna

Sources of test signals for application to the receiver via a test fixture (annex A, clause A.4), a stripline (annex A, clause A.1.7) or a test antenna (annex A, clause A.1.4) shall be connected in such a way that the impedance presented to the test fixture, the stripline or the test antenna is 50 Ω. This requirement shall be met irrespective whether one or more signals using a combining network are applied to the receiver simultaneously.

The levels of the test signals shall be expressed in terms of the emf at the output of the source prior to connection to the receiver input connector.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

7.7 Receiver mute or squelch facility

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

7.8 Encoder for receiver measurements

To facilitate measurements on the receiver, an encoder for the signalling system shall accompany the model submitted, complete with details of the normal modulation process. The encoder shall be used to modulate a signal generator for use as a test signal source.

If possible, the encoder shall be capable of operation in a repetitive mode, with intervals between each code that are not less than the reset time.

Complete details of all codes and code format(s) shall be given.

Details concerning the interconnection of the encoder and the signal generator shall be agreed between the manufacturer and the testing laboratory.

7.9 Facilities for access between the receiver demodulator output and its decoder

When possible, in order to simplify the measurement in clause 9.4, a temporary access between the receiver demodulator output and its decoder input shall be provided for the equipment to be tested.

By this means the measurements in clause 9.4 may be more efficiently carried out using the method of measurement of ETSI EN 300 296 [3], clause 8.6, to determine the points of interest and then to make measurements at those points using the methods of the present document.

7.10 Calling indicator

Any suitable means of indicating that the receiver has responded to a correctly coded input signal may be used.

7.11 Reset

The reset may be a manual or automatic method of cancelling the calling indication and resetting the decoder, enabling it to respond to the next correctly coded input signal.

7.12 Reset time

The reset time of the receiver is the minimum elapsed time between two calls in order that they may both be successfully registered. The reset time shall be declared by the manufacturer in order that the formation of the normal test signal may be derived.

8 Technical characteristics of the transmitter

8.1 Frequency error

8.1.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3]

This measurement is made if the equipment is capable of producing an unmodulated carrier. Otherwise the adjacent channel power shall also be measured under extreme test conditions and the appropriate limits given in clause 8.3.3 shall be met.

8.1.1 Definition

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation and the nominal frequency of the transmitter.

8.1.2 Method of measurement

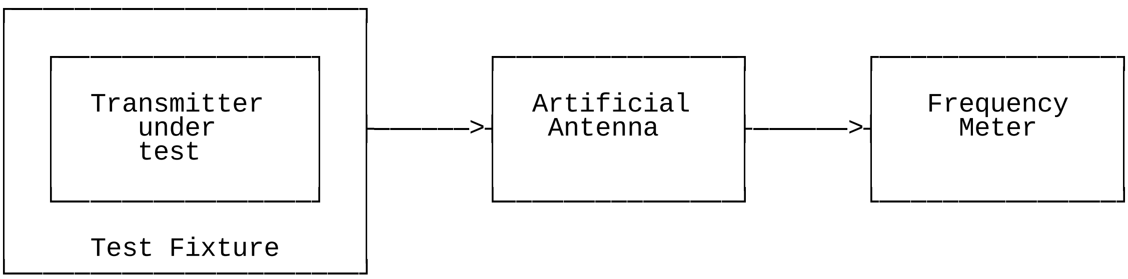


Figure 1: Measurement arrangement

The equipment shall be placed in a test fixture (see annex A, clause A.4) connected to the artificial antenna (see clause 7.2). The carrier frequency shall be measured in the absence of modulation. The measurement shall be made under normal test conditions (see clause 6.3) and repeated under extreme test conditions (clauses 6.4.1 and 6.4.2 applied simultaneously).

8.1.3 Limits

If an unmodulated carrier cannot be obtained, the adjacent channel power shall also be measured under extreme test conditions and the limits given in clause 8.3.3 shall be met.

The frequency error shall not exceed the values given in table 2 under normal, extreme or any intermediate set of conditions. For practical reasons the measurements will be performed only under normal and extreme test conditions as defined in clause 8.1.2.

Table 2: Frequency error

	Frequency error limits (kHz)				
Channel separation (kHz)	Below 47 MHz	47 MHz to 137 MHz	Above 137 MHz to 300 MHz	Above 300 MHz to 500 MHz	Above 500 MHz to 1 000 MHz
20 and 25	±0,60	±1,35	±2,00	±2,00 (a)	±2,50 (a)
12,5	±0,60	±1,00	±1,00 (B) ±1,50 (M)	±1,00 (B) ±1,50 (a, M)	no value specified

NOTE: B = base station
M = mobile or handportable station
(a) for handportable stations having integral power supplies, the figures given in the table with the suffix (a) only apply to the reduced extreme temperature range 0 °C to + 30 °C.
However, for the full extreme temperature conditions (see clause 6.4.1), exceeding the reduced extreme temperature range, the following frequency error limits apply:
- ±2,50 kHz between 300 and 500 MHz;
- ±3,00 kHz between 500 and 1 000 MHz.

8.2 Effective radiated power

8.2.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

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 supplier. The power adjustment control shall not be accessible to the user.

The requirements of the present document shall be met for all power levels at which the transmitter is intended to operate. For practical reasons measurements shall be performed only at the lowest and the highest power level at which the transmitter is intended to operate.

8.2.1 Definition

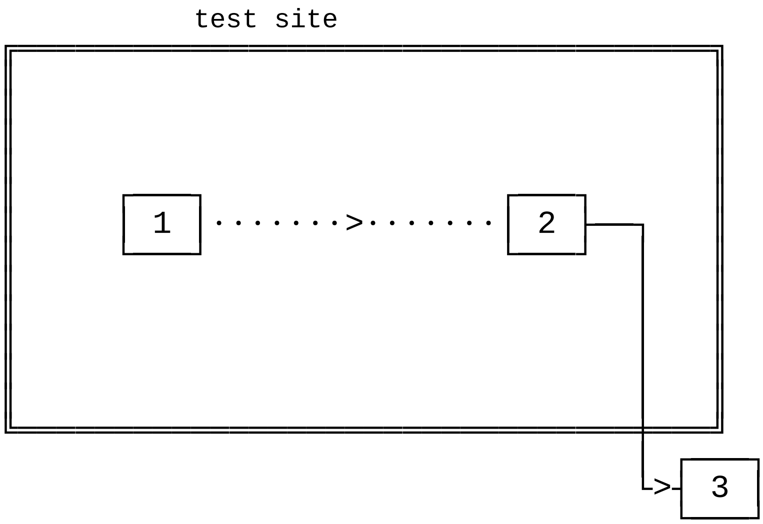
The effective radiated power is the power radiated in the direction of the maximum field strength under specified conditions of measurement.

The rated effective radiated power is the effective radiated power of the equipment as declared by the supplier.

8.2.2 Method of measurement

8.2.2.1 Maximum effective radiated power under normal test conditions

The measurements shall be made under normal test conditions, (see clause 6.3), and extreme test conditions, (clauses 6.4.1 and 6.4.2 applied simultaneously).



NOTE 1: Transmitter under test
NOTE 2: Test antenna
NOTE 3: Spectrum analyser or selective voltmeter (test receiver)

Figure 2: Measurement arrangement

a) A test site which fulfils the requirements of the specified frequency range of this measurement shall be used. The test antenna shall be oriented initially for vertical polarization unless otherwise stated.

   The transmitter under test shall be placed on the support in its standard position (see annex A) and switched on without modulation.

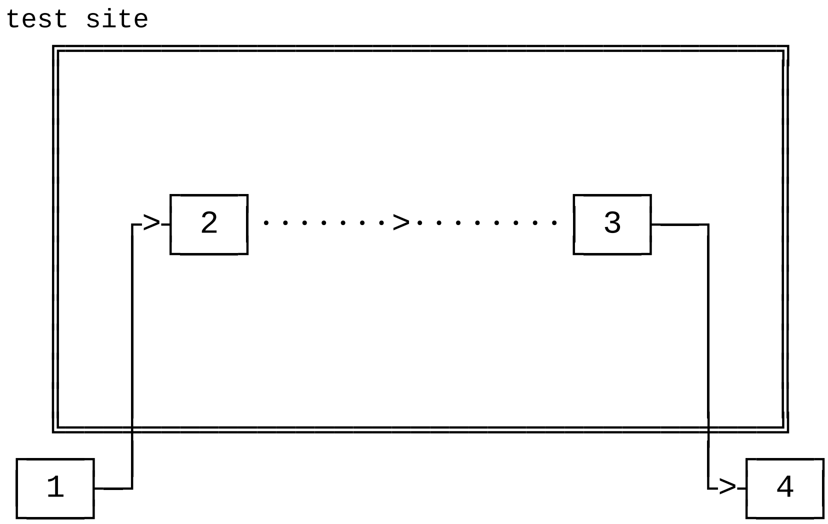
b) The spectrum analyser or selective voltmeter shall be tuned to the transmitter carrier frequency. The test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

   The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1 (i.e. an anechoic chamber).

c) The transmitter shall be rotated through 360° about a vertical axis until a higher maximum signal is received.

d) The test antenna shall be raised or lowered again through the specified height range until a maximum is obtained. This level shall be recorded. (This maximum may be a lower value than the value obtainable at heights outside the specified limits).

   The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1.



NOTE 1: Signal generator
NOTE 2: Substitution antenna
NOTE 3: Test antenna
NOTE 4: Spectrum analyser or selective voltmeter (test receiver)

Figure 3: Measurement arrangement

e) Using the measurement arrangement of figure 3 the substitution antenna, shall replace the transmitter antenna in the same position and in vertical polarization. The frequency of the signal generator shall be adjusted to the transmitter carrier frequency. The test antenna shall be raised or lowered as necessary to ensure that the maximum signal is still received.

   The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1.

   The input signal to the substitution antenna shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver. The maximum carrier radiated power is equal to the power supplied by the signal generator, increased by the known relationship if necessary and after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna.

f) Steps b) to e) above shall be repeated with the test antenna and the substitution antenna oriented in horizontal polarization.

8.2.2.2 Average effective radiated power under normal test conditions

a) The procedures in steps b) to f) shall be repeated, except that in step c) the transmitter shall be rotated through 8 positions, 45° apart, starting at the position corresponding to maximum effective radiated power.

b) The average effective radiated power corresponding to the eight average values is given by:

$$\textit{average 8 power} = \frac{\sum_{1}^{8} P_n}{8}$$

   where P_n is the power corresponding to each of the eight positions.

8.2.3 Method of measurements of maximum and average effective radiated power under extreme test conditions

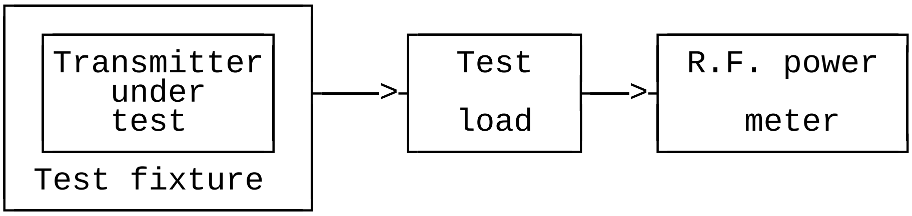


Figure 4: Measurement arrangement

a) The measurement specified in clause 8.2.2 shall also be performed under extreme test conditions. Due to the impossibility of repeating the above measurement on a test site under extreme temperature conditions, only a relative measurement is performed, using the test fixture (see annex A, clause A.4) and the measurement arrangement of figure 4.

b) The power delivered to the test load under normal test conditions (see clause 6.3) shall be measured and noted. Then the power under extreme test conditions (clauses 6.4.1 and 6.4.2 applied simultaneously) shall be measured and noted. The difference in dB shall be calculated. This difference is algebraically added to the average effective radiated power under normal test conditions, in order to obtain the average effective radiated power under extreme test conditions.

c) A similar calculation will provide the maximum effective radiated power.

d) Additional uncertainties can occur under extreme test conditions due to the calibration of the test fixture.

8.2.4 Limits

The effective radiated power under normal test conditions shall be within d_f from the rated effective radiated power.

The allowance for the characteristics of the equipment (±1,5 dB) shall be combined with the actual measurement uncertainty in order to provide d_f as follows:

$d_f^2 = d_m^2 + d_e^2$

where:

- d_m is the actual measurement uncertainty;
- d_e is the allowance for the equipment (1,5 dB);
- d_f is the final difference.

All values shall be expressed in linear terms.

In all cases the actual measurement uncertainty shall comply with clause 11.

Furthermore, the maximum effective radiated power shall not exceed the maximum value allowed by the Administrations.

Example calculation of d_f:

d_m = 6 dB (value acceptable, as indicated in the table of maximum uncertainties);

= 3,98 in linear terms;

d_e = 1,5 dB (fixed value for all equipment fulfilling the requirements of the present document);

= 1,41 in linear terms;

$d_f^2 = (3{,}98)^2 + (1{,}41)^2$;

Therefore, d_f = 4,22 in linear terms or 6,25 dB.

This calculation shows that in this case d_f exceeds d_m, the actual measurement uncertainty (6 dB) by 0,25 dB.

8.3 Adjacent and alternate channel power

8.3.0 Applicability

This measurement shall be carried out whether or not the equipment has previously been tested to the requirements of ETSI EN 300 296 [3].

8.3.1 Definition

The adjacent channel power is that part of the total output power 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.

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

8.3.2 Method of measurement

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

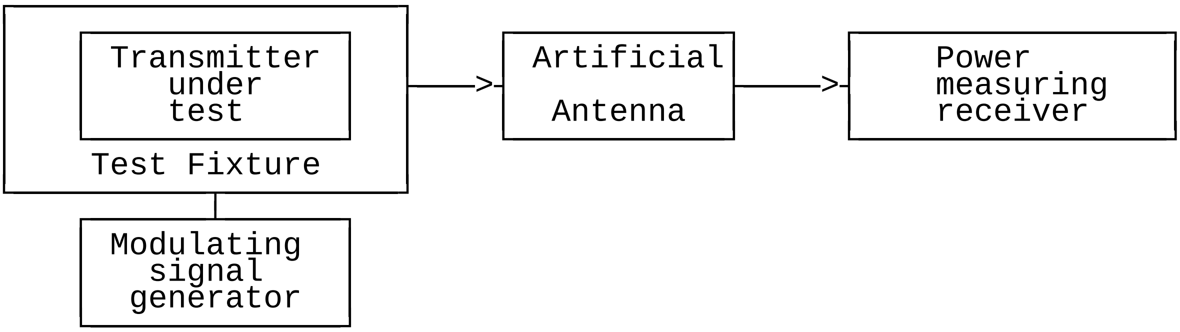


Figure 5: Measurement arrangement

a) The transmitter under test shall be placed in the test fixture (see annex A, clause A.4) connected via the artificial antenna (see clause 7.2) to a power measuring receiver calibrated to measure root mean square (r.m.s) 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.

b) With the transmitter unmodulated, the tuning of the power-measuring receiver shall be adjusted so that a maximum response is obtained. This is the 0 dB response point. The power measuring receiver attenuator setting and the reading of the meter shall be recorded.

c) 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 3a.

Table 3a: Frequency displacement

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

The same result may be obtained by tuning the power-measuring receiver (point D2 in the drawing of the power measuring filter shape) to the nominal frequency of the adjacent channel, if it has been suitably calibrated.

d) The transmitter shall be modulated by the test signal D-M4 (see clause 7.1) If the equipment is intended to operate with combined analogue speech and signalling then the transmitter shall also be modulated by a test signal of 1 250 Hz at a level which is 20 dB higher than that required to produce 60 % of the maximum permissible frequency deviation.

e) The power measuring receiver variable attenuator shall be adjusted to obtain the same meter reading as in step b) or a known relation to it. This value shall be recorded.

f) The ratio of adjacent channel power to carrier power is the difference between the attenuator settings in step b) and e), corrected for any differences in the reading of the meter. Alternatively the absolute value of the adjacent channel power may be calculated from the above ratio and the transmitter carrier power.

g) Steps c) to f) shall be repeated with the power measuring receiver tuned to the other side of the carrier.

h) For the purpose of equipment which is not capable of producing an unmodulated carrier (see clause 8.1), the measurement shall be repeated under extreme test conditions (clauses 6.4.1 and 6.4.2 applied simultaneously).

i) Steps c) to g) shall be repeated for the alternate channel with the values of table 3b.

Table 3b: Frequency displacement

Channel separation (kHz)	Displacement (kHz)
12,5	20,75
20	33
25	42

j) The adjacent channel power of the equipment under test shall be expressed as the higher of the two values recorded in step f) for the upper and lower adjacent channels.

The alternate channel power of the equipment under test shall be expressed as the higher of the two values recorded in step f) for the upper and lower alternate channels.

8.3.3 Limits

For a channel separation of 12,5 kHz, 20 kHz and 25 kHz, the adjacent channel power and the alternate channel power shall not exceed a value of 60,0 dB below the transmitter power (conducted) without the need to be below 0,2 µW (-37 dBm).

For channel separations of 20 kHz and 25 kHz, the alternate channel power shall not exceed a value of 70,0 dB below the carrier power (conducted) of the transmitter without the need to be below 0,20 µW (-37 dBm). For a channel separation of 12,5 kHz, the alternate channel power shall not exceed a value of 60 dB below the transmitter carrier power without the need to be below 0,20 µW(-37 dBm).

In the case where the equipment is not capable of producing an unmodulated carrier these measurements shall also be performed under extreme test conditions except where equipment has already been tested to the requirements of ETSI EN 300 296 [3]. Under these extreme test conditions the measured adjacent channel power shall not exceed a value of 65 dB below the carrier for equipment with channel separations of 20 kHz and 25 kHz and 55 dB for channel separations of 12,5 kHz, without the need to be below 0,20 µW.

8.4 Radiated spurious emissions

8.4.0 Applicability

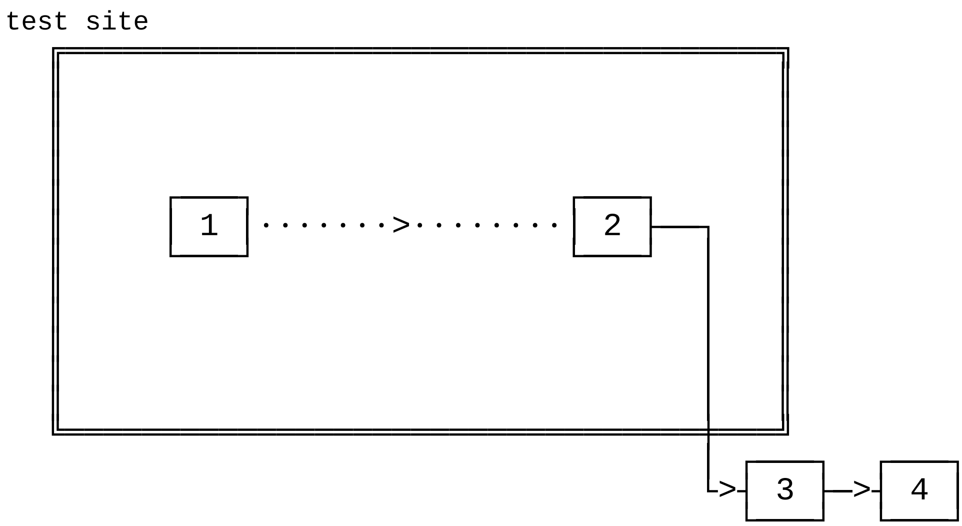
This measurement shall be carried out subject to the provisions of clause 4.

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

8.4.2 Method of measurement



NOTE: 1) Transmitter under test
2) Test antenna
3) High 'Q' (notch) or high pass filter
4) Spectrum analyser or selective voltmeter (test receiver)

Figure 6: Measurement arrangement

a) A test site, which fulfils the requirements of the specified frequency range of this measurement, shall be used. The test antenna shall be oriented initially for vertical polarization and connected to a spectrum analyser or a selective voltmeter, through a suitable filter to avoid overloading of the spectrum analyser or selective voltmeter. In the case of measurements performed with an unmodulated carrier, the bandwidth of the spectrum analyser or selective voltmeter shall be between 10 kHz and 120 kHz, set to a suitable value to correctly perform the measurement.

- For the measurement of spurious emissions below the second harmonic of the carrier frequency the filter used shall be a high "Q" (notch) filter centred on the transmitter carrier frequency and attenuating this signal by at least 30 dB.

- For the measurement of spurious emissions at and above the second harmonic of the carrier frequency the filter used shall be a high pass filter with a stop band rejection exceeding 40 dB. The cut-off frequency of the high pass filter shall be approximately 1,5 times the transmitter carrier frequency.

- The transmitter under test shall be placed on the support in its standard position (see annex A) and shall be switched on without modulation.

- If an unmodulated carrier cannot be obtained then the measurements shall be made with the transmitter modulated by the test signal D-M4 (see clause 7.1) in which case this fact shall be recorded in the test report.

b) The radiation of any spurious emission shall be detected by the test antenna and spectrum analyser or selective voltmeter over the frequency range 30 MHz to 4 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels. In addition, for equipment operating on frequencies above 470 MHz, measurements shall be repeated over the frequency range 4 GHz to 12,75 GHz. The frequency of each spurious emission detected shall be recorded. If the test site is disturbed by interference coming from outside, this qualitative search may be performed in a screened room, with a reduced distance between the transmitter and the test antenna.

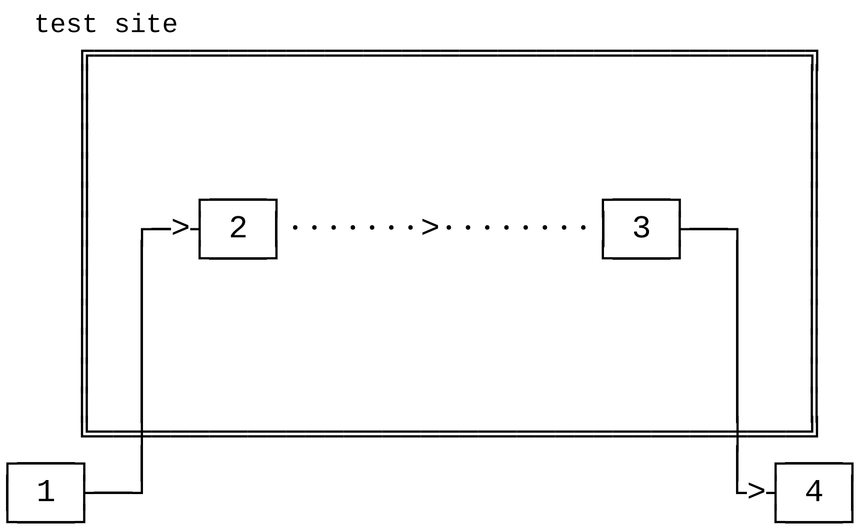
c) At each frequency at which an emission has been detected, the spectrum analyser or selective voltmeter shall be tuned and the test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1 (i.e. an anechoic chamber).

d) The transmitter shall be rotated through 360° about a vertical axis, until a higher maximum signal is received.

e) The test antenna shall be raised or lowered again through the specified height range until a maximum is obtained. This level shall be recorded.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1.



NOTE: 1) Signal generator
2) Substitution antenna
3) Test antenna
4) Spectrum analyser or selective voltmeter (test receiver)

Figure 7: Measurement arrangement

f) Using the measurement arrangement of figure 7, the substitution antenna shall replace the transmitter antenna in the same position and in vertical polarization. It shall be connected to the signal generator.

g) At each frequency at which an emission has been detected, the signal generator, substitution antenna, and spectrum analyser or selective voltmeter shall be correspondingly tuned. The test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1.

The level of the signal generator giving the same signal level on the spectrum analyser or selective voltmeter as in item e) above shall be recorded. This value, after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna, is the radiated spurious emission at this frequency.

As a general rule, the resolution bandwidth of the measuring receiver should be equal to the reference bandwidth.

"To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth can be different from the reference bandwidth. When the resolution bandwidth is smaller than the reference bandwidth, the result should be integrated over the reference bandwidth. When the resolution bandwidth is greater than the reference bandwidth, the result for broadband spurious emissions should be normalized to the bandwidth ratio. For discrete spur, normalization is not applicable, while integration over the reference bandwidth is still applicable." (extract from CEPT/ERC/REC 74-01E [i.4], recommend 4, page 5).

The conditions used in the measurement shall be recorded in the test report.

h) Steps c) to g) above shall be repeated with the test antenna oriented in horizontal polarization.

i) Steps c) to h) above shall be repeated with the transmitter in stand-by condition if this option is available.

8.4.3 Limits

The power of any spurious emission shall not exceed the values given in tables 4 and 5a.

Table 4: Conducted emissions

Frequency range	Tx operating	Tx standby
9 kHz to 1 GHz	0,25 µW (-36 dBm)	2,0 nW (-57 dBm)
1 GHz to 4 GHz, or 1 GHz to 12,75 GHz (clause 8.5.2)	1,00 µW (-30 dBm)	20 nW (-47 dBm)

Table 5a: Radiated emissions

Frequency range	Tx operating	Tx standby
30 MHz to 1 GHz	0,25 µW (-36 dBm)	2,0 nW (-57 dBm)
1 GHz to 4 GHz	1,00 µW (-30 dBm)	20 nW (-47 dBm)

In the case of radiated measurements for handportable stations the following conditions apply:

- for equipment with an internal integral antenna: the normal antenna shall remain connected;
- for equipment with an external antenna socket: an artificial load shall be connected to the socket for the test.

The reference bandwidths used shall be as stated in tables 5b and 5c.

Table 5b: Reference bandwidths to be used for the measurement of spurious emission

Frequency range	RBW
30 MHz to 1 GHz	100 kHz
1 GHz to 12,75 GHz	1 MHz

Table 5c: Reference bandwidths to be used close to the wanted emission

Frequency offset from carrier	RBW
250 % of the CSP to 100 kHz	1 kHz
100 kHz to 500 kHz	10 kHz

8.5 Transient frequency behaviour of the transmitter

8.5.0 Applicability

This measurement does not apply to equipment designed for continuous transmission only.

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

8.5.1 Definitions

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

t_{on}: according to the method of measurement described in clause 8.5.2 the switch-on instant t_{on} of a transmitter is defined by the condition when the output power, measured at the antenna terminal, exceeds 0,1 % of the nominal power (-30 dBc).

t_1: period of time starting at t_{on} and finishing according to table 6.

t_2: period of time starting at the end of t_1 and finishing according to table 6.

t_{off}: switch-off instant defined by the condition when the nominal power falls below 0,1 % of the nominal power (-30 dBc).

t_3: period of time that finishing at t_{off} and starting according to table 6.

8.5.2 Method of measurement

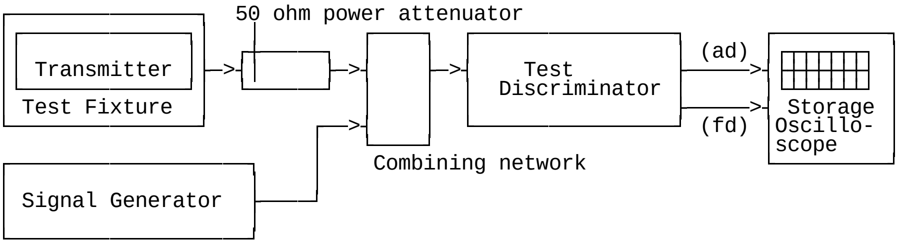


Figure 8: Measurement arrangement

The transmitter shall be placed in the test fixture (see annex A, clause A.4) and the measurement arrangement shown in figure 8 shall be used.

Two signals shall be connected to the test discriminator via a combining network, clause 7.6.

The transmitter output from the test fixture shall be connected to a 50 Ω power attenuator.

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

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

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

The test signal shall be modulated by a frequency of 1 kHz with a deviation equal to ± the value of the relevant channel separation.

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

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

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

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

The display will show the 1 kHz test signal continuously.

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

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

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

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

The periods of time t_1 and t_2 as defined in table 6, shall be used to define the appropriate template.

During the period of time t_1 and t_2 the frequency difference shall not exceed the values given in clause 8.5.3.

The frequency difference, after the end of t_2, shall be within the limit of the frequency error, clause 8.1.3.

The result shall be recorded as frequency difference versus time.

The transmitter shall remain switched on.

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

The transmitter shall then be switched off.

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

The period of time t_3 as defined in table 6, shall be used to define the appropriate template.

During the period of time t_3 the frequency difference shall not exceed the values given in clause 8.5.3.

Before the start of t_3 the frequency difference shall be within the limit of the frequency error, clause 8.1.3.

The result shall be recorded as frequency difference versus time.

Figure 9 represents the storage oscilloscope view t_1, t_2 and t_3 for the case of equipment operating in the frequency range 300 to 500 MHz.

If an unmodulated carrier cannot be obtained then the measurements shall be made with the transmitter modulated by the test signal D-M4 (see clause 7.1) and an extra ½ channel separation will be accepted for the limit of the peak frequency difference.

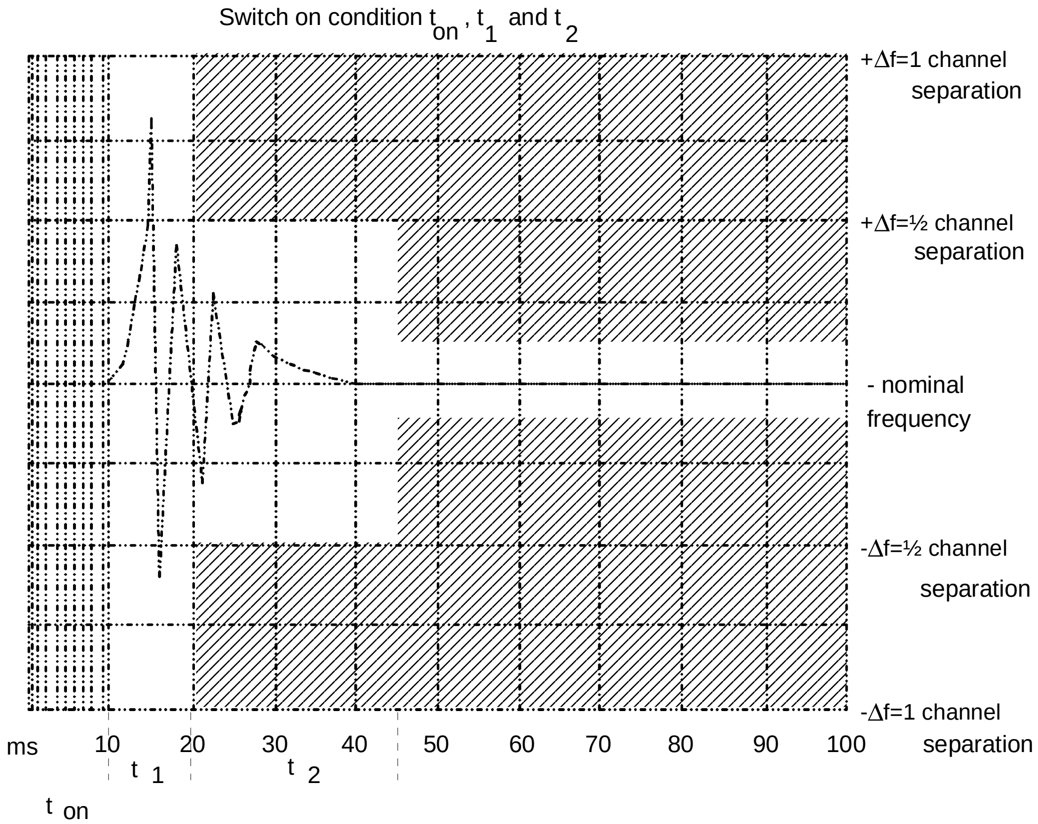
If the display of the oscilloscope shows a large impulse immediately after the end of the calibration signal, there is a risk that this signal may be caused by the phase shift between the calibration signal and the transmitter.

To identify the source of the impulse, the following method can be used.

The impulse can be evaluated by repeating the test, e.g. for three times.

If the impulse remains constant in amplitude and exceeds the limit then the transmitter fails to meet the test.

If the impulse changes amplitude it is a phase shift occurring from the method of testing and this impulse shall be disregarded in the assessment of the test results.



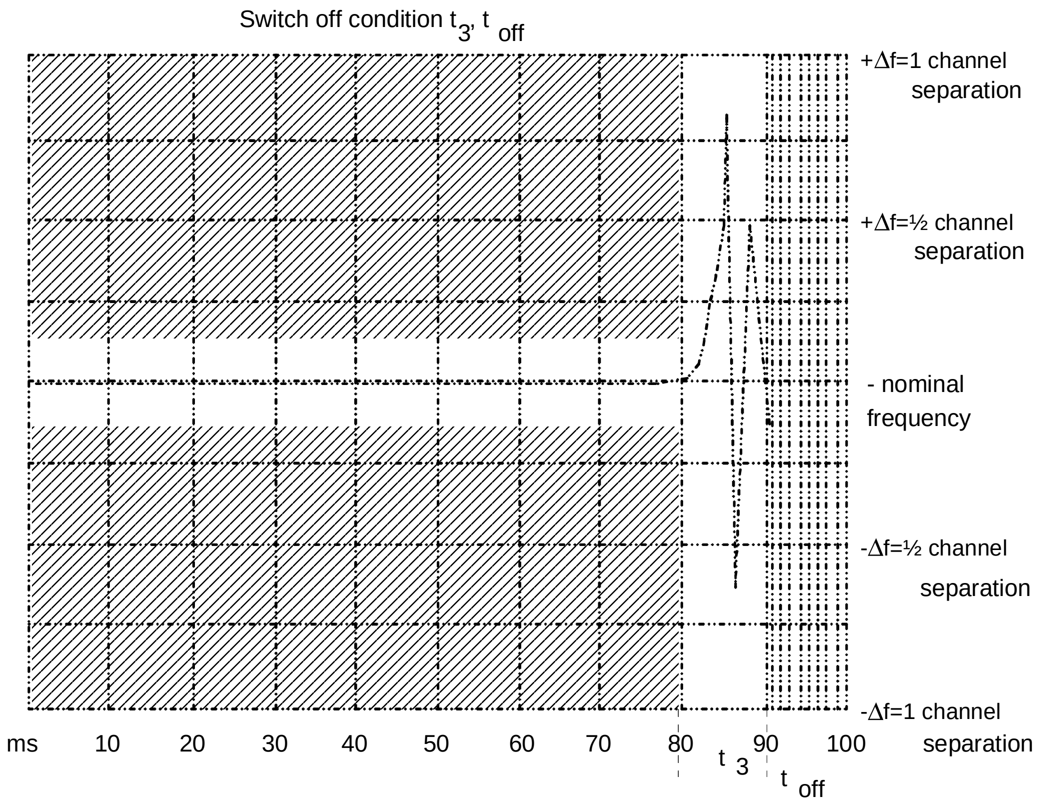


Figure 9: Storage oscilloscope view t_1, t_2 and t_3

8.5.3 Limits

The transient periods are given in table 6. The transient periods for the frequency range > 300 MHz to 500 MHz are shown as an example in figure 11, clause 9.1.3.

Table 6: Transient periods

	30 MHz to 300 MHz	300 mHz to 500 MHz	500 MHz to 1 000 MHz
t1 (ms)	5,0	10,0	20,0
t2 (ms)	20,0	25,0	50,0
t3 (ms)	5,0	10,0	10,0

During the periods t1 and t3 the frequency difference shall not exceed the value of 1 channel separation.

During the period t2 the frequency difference shall not exceed the value of half a channel separation.

In the case of equipment where an unmodulated carrier cannot be obtained, an additional ½ channel separation will be accepted for the limit of the peak frequency difference, during t1, t2 and t3.

9 Technical characteristics of the receiver

9.1 Average usable sensitivity (field strength, responses)

9.1.0 Applicability

This measurement shall be carried out whether or not the equipment has previously been tested to the requirements of ETSI EN 300 296 [3].

9.1.1 Definition

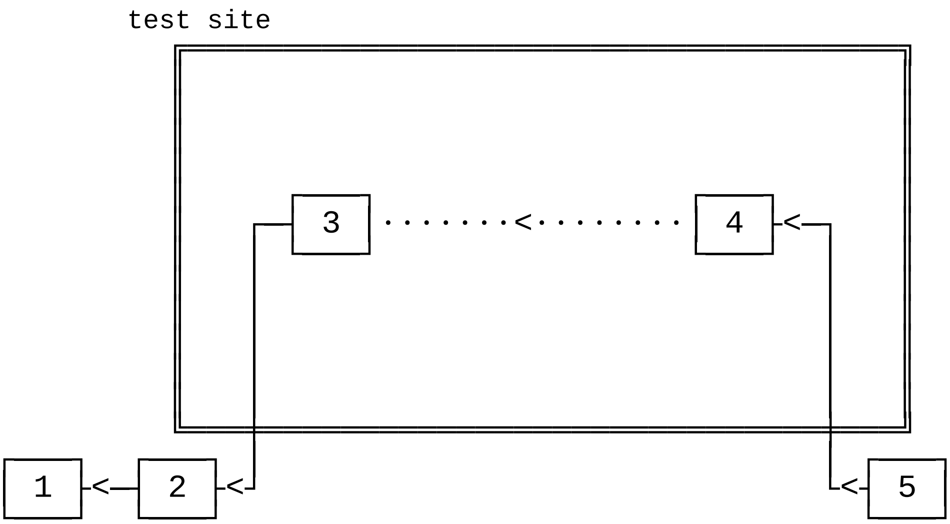
The average usable sensitivity (responses) expressed as field strength is the average field strength, expressed in dBμV/m, produced by a carrier at the nominal frequency of the receiver, modulated with the normal test signal D-M3 (see clause 7.1) which will, without interference, produce after demodulation a specified successful response ratio. The average is calculated from 8 measurements of field strength when the receiver is rotated in 45° increments starting at a particular orientation.

NOTE: The average usable sensitivity mostly differs only by a small amount from the maximum usable sensitivity to be found in a particular direction. This is due to the properties of the averaging process as used in the formula in clause 9.1.2 j). For instance, an error not exceeding 1,2 dB can be found if the sensitivity is equal in seven directions and is extremely bad in the eighth direction. For the same reason the starting direction (or angle) can be selected randomly.

9.1.2 Method of measurement under normal test conditions

Arrangements shall be made to couple the equipment under test to the calling indicator by a method, which does not affect the radiated field (see annex A, clause A.3).

A test site, which fulfils the requirements of the specified frequency range of this measurement, shall be used. The test antenna shall be orientated for vertical polarization or for the polarization in which the equipment under test is intended to operate.



NOTE: 1) Calling indicator
2) Photo detector/acoustic coupler
3) Receiver under test
4) Test antenna
5) Signal generator

Figure 10: Measurement arrangement

a) A signal generator shall be connected to the test antenna.

The signal generator shall be at the nominal frequency of the receiver and shall be modulated with normal test signal D-M3.

The receiver under test shall be placed on the support in its standard position and in a random orientation. A calling indicator shall be connected to the receiver, preferably via a photo detector or an acoustic coupler (see annex A, clause A.3) in order to avoid disturbing the electromagnetic field in the vicinity of the equipment.

b) The level of the signal generator shall be adjusted until a successful response ratio of less than approximately 10 % is obtained.

c) The test antenna shall be raised or lowered through the specified height range to find the maximum response ratio.

The level of the test signal shall be re-adjusted to produce the response ratio specified in step b).

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1 (i.e. an anechoic chamber).

d) Note the minimum signal generator level from step b) or c) as appropriate.

e) The normal test signal shall be transmitted repeatedly whilst observing in each case whether or not a successful response is obtained.

The level of the test signal shall be increased by 2 dB for each occasion that a successful response is not obtained. The procedure shall be continued until three consecutive responses are observed.

NOTE: This level is the minimum signal generator level in this direction.

f) The level noted in step e) shall be reduced by 1 dB and the new value also noted. The normal test signal D-M3 shall then be transmitted 20 times. In each case, if a response is not obtained, the level shall be increased by 1 dB and the new value noted. If a successful response is obtained, the level shall not be changed until three consecutive successful responses have been observed. In this case, the level shall be reduced by 1 dB and the new value noted. No signal level shall be noted unless preceded by a change in level.

The average of the values noted corresponds to the successful response ratio of 80 %. It shall be used to calculate the field strength associated with each position in step h).

g) Steps b) to f) above shall be repeated for the remaining seven positions (45° apart) of the receiver, and the corresponding average values of the generator output (corresponding to successful response ratios of 80 %) shall be determined and recorded.

h) Using the relationship described in annex A, calculate and record the eight field strengths X_i in µV/m corresponding to the above average values.

i) The average sensitivity expressed as field strength E_{mean} (dBµV/m) is given by:

$$E_{mean} = 20 \log \left(\sqrt{\left(\frac{8}{\sum_{i=1}^{i=8} \frac{1}{X_i^2}} \right)} \right)$$

where X_i represents each of the eight field strengths calculated in step h). The recorded result is the average usable sensitivity expressed in dBµV/m.

j) The reference direction is defined as the direction at which the maximum sensitivity level (i.e. the minimum field strength for the responses noted during the measurement) occurred in the eight measuring positions.

The corresponding direction, height (where applicable) and this reference field strength value shall be recorded.

9.1.3 Method of measurement of the average usable sensitivities under extreme test conditions

Using the test fixture in the measurement arrangement of figure 11, the measurement of the average usable sensitivity shall also be performed under extreme test conditions.

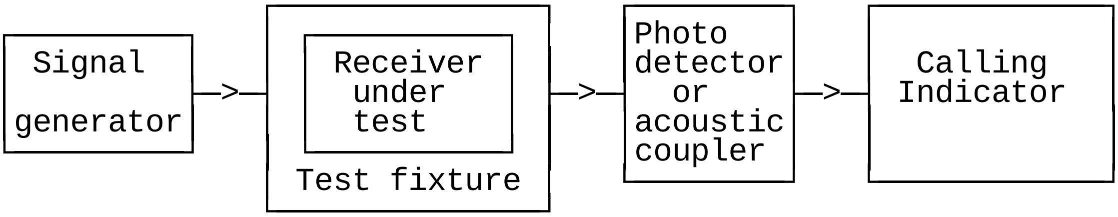


Figure 11: Measurement arrangement

The test signal input level providing a successful response ratio of 80 % shall be determined under extreme and under normal test conditions and the difference in dB shall be calculated. This difference shall be added to the average measured usable sensitivity to radiated fields expressed in dBµV/m, as calculated in clause 9.1.2 j), under normal test conditions, to obtain the sensitivity under extreme test conditions.

9.1.4 References for degradation measurements

9.1.4.1 Definition

Degradation measurements are those measurements made on the receiver to establish the degradation of the performance of the receiver due to the presence of an unwanted (interfering) signal. For such measurements, the level of the unwanted signal shall be adjusted to a level, which is 3 dB above the limit of the average usable sensitivity.

Degradation measurements fall into two categories:

a) those carried out on a test site (see clauses 9.4, 9.6, and annex A); and

b) those carried out using a test fixture (see clauses 9.2, 9.3, 9.5 and annex A, clause A.4).

The test fixture is only used for those tests where the difference in frequency between the wanted and unwanted test signals is very small in relation to the actual frequency, so that the coupling loss is the same for the wanted and unwanted test signals fed into the test fixture.

9.1.4.2 Procedures for measurements using the test fixture

The test fixture is coupled to the signal generators via a combining network to provide the wanted and unwanted test input signals to the receiver in the test fixture. It is necessary therefore to establish the output level of the wanted test signal from the signal generator that results in a signal at the receiver (in the test fixture) which corresponds with the average usable sensitivity (radiated) as specified in clause 9.1.5.

This test output level from the signal generator for the wanted test signal is then used for all the receiver measurements using the test fixture.

The method for determining the test output level from the signal generator is as follows:

a) the actual average usable sensitivity of the receiver is measured in accordance with clause 9.1.2 j) and expressed as a field strength;

b) the difference between the limit of the average usable sensitivity specified in clause 9.1.5, and this actual average usable sensitivity, expressed in dB, is noted;

c) the receiver is then mounted in the test fixture:

   the signal generator providing the wanted input signal is coupled to the test fixture via a combining network. All other input ports of the combining network are terminated in 50Ω loads;

   the output from the signal generator with normal test modulation D-M3 (see clause 7.1) is adjusted so that the successful response ratio of 80 % is obtained (see clause 9.1.2 f)). This output level is then increased by an amount equal to the difference expressed in dB calculated in clause 9.1.4.2 b);

   the output level of the signal generator A is defined as being the level equivalent to the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength (see clause 9.1.5).

9.1.4.3 Procedures for measurements using the test site

When measurements are carried out on a test site, the wanted and unwanted signals shall be calibrated in terms of dBμV/m at the location of the equipment under test.

For measurements according to clauses 9.4, 9.6 and annex A, the height of the test antenna and the direction (angle) of the equipment under test shall be that recorded in clause 9.1.2 j) (reference direction).

9.1.5 Limits

For the average usable sensitivity limits, four categories of equipment are defined as follows:

Category A: equipment having an integral antenna fully within the case;

Category B: equipment having an extractable or fixed integral antenna, with an antenna length not exceeding 20 cm external to the case;

Category C: equipment having an extractable or fixed integral antenna, with an antenna length exceeding 20 cm external to the case;

Category D: equipment not covered by category A, B or C.

Under normal test conditions, the average usable sensitivity shall not exceed the following field strength values.

Table 7a: Sensitivity limits for Categories A and D

Frequency band (MHz)	Average usable sensitivity in dB relative to 1 µV/m
30 to 400	27,0
> 400 to 750	28,5
> 750 to 1 000	30,0

Table 7b: Sensitivity limits for Category B

Frequency band (MHz)	Average usable sensitivity in dB relative to 1 µV/m
30 to 130	18,0
> 130 to 300	19,5
> 300 to 440	21,5
> 440 to 600	23,5
> 600 to 800	25,5
> 800 to 1 000	28,0

Category C:

At frequencies greater than 375 MHz the limits shall be as specified in table 7b.

In the case of frequencies less than or equal to 375 MHz a correction factor K, shall be subtracted from the specified field strengths in table 7b:

- $K = 20 \log_{10} [(l+20)/40]$;

where l is the external part of the antenna in cm.

This correction only applies if the antenna length external to the case is less than (15 000/f_o - 20) in cm, where f_o is the frequency in MHz (applicable to frequencies below 375 MHz).

For all categories of equipment, add 6 dB to the limit under normal test conditions to obtain the limit under extreme test conditions.

9.2 Co-channel rejection

9.2.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

9.2.1 Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

9.2.2 Method of measurement

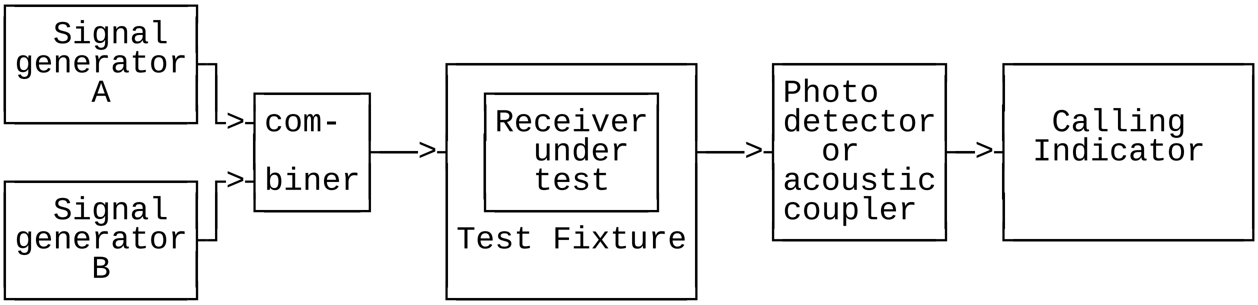


Figure 12: Measurement arrangement

a) The receiver shall be placed in the test fixture.

Two signal generators A and B shall be connected to the test fixture via a combining network. The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation D-M3 (see clause 7.1).

The unwanted signal, represented by signal generator B, shall be modulated with signal A-M3 (see clause 7.1). Both input signals shall be at the nominal frequency of the receiver under test.

b) Initially the unwanted signal shall be switched off (maintaining its output impedance).

The level of the wanted signal from generator A shall be adjusted to a level which is 3 dB above the level equivalent to the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength (clauses 9.1.5 and 9.1.4).

c) The unwanted signal from generator B shall then be switched on and its level shall be adjusted until a successful response ratio of less than 10 % is obtained.

d) The normal test signal D-M3 shall be transmitted repeatedly whilst observing in each case whether or not a successful response is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not obtained.

The procedure shall be continued until three consecutive successful responses are observed.

The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal D-M3 shall then be transmitted 20 times. In each case, if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a successful response is obtained the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained.

In this case the unwanted signal shall be increased by 1 dB and the new value noted.

No level of the unwanted signal shall be noted unless preceded by a change in level. The average of the values noted in steps d) and e) (which provides the level corresponding to the successful response ratio of 80 %) shall be recorded.

f) For each frequency of the unwanted signal, the co-channel rejection ratio shall be expressed as the ratio, in dB, of the average level recorded in step e) to the level of the wanted signal.

g) The measurement shall be repeated for displacements of the unwanted signal of ±12 % of the channel separation.

h) The co-channel rejection ratio of the equipment under test shall be expressed as the lowest of the three values expressed in dB, recorded in step f).

9.2.3 Limits

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurement shall be:

- between -8,0 dB and 0 dB for channel separations of 20 kHz and 25 kHz;
- between -12,0 dB and 0 dB for channel separation of 12,5 kHz.

9.3 Adjacent channel selectivity

9.3.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

9.3.1 Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

9.3.2 Method of measurement

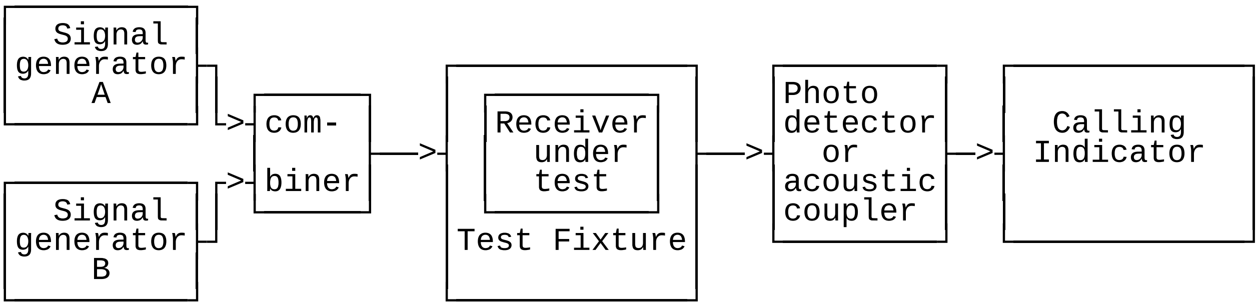


Figure 13: Measurement arrangement

a) The receiver shall be placed in the test fixture.

Two signal generators A and B shall be connected to the test fixture via a combining network.

The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation D-M3 (see clause 7.1).

The unwanted signal, represented by signal generator B, shall be modulated with signal A-M3 (see clause 7.1) and shall be at the frequency of the channel immediately above that of the wanted signal.

b) Initially the unwanted signal shall be switched off (maintaining its output impedance).

The level of the wanted signal from generator A shall be adjusted to a level which is 3 dB above the level equivalent to the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength (see clauses 9.1.5 and 9.1.4).

c) The unwanted signal from generator B shall then be switched on, and its level shall be adjusted until a successful response ratio of less than 10 % is obtained.

d) The normal test signal D-M3 shall be transmitted repeatedly whilst observing in each case whether or not a successful response is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not obtained.

The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal D-M3 shall then be transmitted 20 times. In each case, if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the new value noted.

No level of the unwanted signal shall be noted unless preceded by a change in level.

The average of the values noted in steps d) and e) (which provides the level corresponding to the successful response ratio of 80 %) shall be recorded.

f) For each adjacent channel, the selectivity shall be expressed as the ratio in dB of the average level recorded in step e) to the level of the wanted signal.

It shall then be converted back into field strengths of the unwanted signals at the receiver location and expressed in dBμV/m.

g) The measurement shall be repeated with the unwanted signal at the frequency of the channel below that of the wanted signal.

h) The adjacent channel selectivity of the equipment under test shall be expressed as the lower of the two values measured in the upper and lower channel nearest to the receiving channel.

i) The measurement shall be repeated under extreme test conditions (clauses 6.4.1 and 6.4.2 applied simultaneously), with the level of the wanted signal adjusted to a level which is 6 dB above the level equivalent to the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength (see clause 9.1.4).

9.3.3 Limits

For the definition and the method of measurement see clause 9.3.

The adjacent channel selectivity of the equipment shall be such that under the specified test conditions, the given degradation shall not be exceeded for levels of the unwanted signal up to those given in table 8.

Table 8: Adjacent channel selectivity

Channel separation (kHz)	**Adjacent channel selectivity limit (dBμV/m)**			
	Unwanted frequencies ≤ 68 MHz		**Unwanted frequencies > 68 MHz**	
	Normal test conditions	**Extreme test conditions**	**Normal test conditions**	**Extreme test conditions**
20 & 25	75	65	$20 \log_{10}(f) + 38,3$	$20 \log_{10}(f) + 28,3$
12,5	65	55	$20 \log_{10}(f) + 28,3$	$20 \log_{10}(f) + 18,3$
NOTE: f is the carrier frequency in MHz.				

9.4 Spurious response rejection

9.4.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

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

9.4.1 Definition

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

9.4.2 Introduction to the method of measurement

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

a) calculation of the "limited frequency range":

the limited frequency range is equal to the frequency of the local oscillator signal (f_{lo}) applied to the 1st mixer of the receiver plus or minus the sum of the intermediate frequencies (f_{i1},...f_{in}) and a half the switching range (sr) of the receiver, clause 4.

Hence the frequency f_l of the limited frequency range is:

$$f_{lo} - \sum_{i=1}^{i=n} f_i - \frac{sr}{2} \leq f_l \leq f_{lo} + \sum_{i=1}^{i=n} f_i + \frac{sr}{2}$$

b) calculation of frequencies outside the limited frequency range:

a calculation of the frequencies at which spurious responses can occur outside the range determined in a) is made for the remainder of the frequency range of interest, as appropriate, clause 9.4.5 g).

The frequencies outside the limited frequency range are equal to the harmonics of the frequency of the local oscillator signal (f_{lo}) applied to the 1st mixer of the receiver plus or minus the 1st intermediate frequency (f_{i1}) of the receiver.

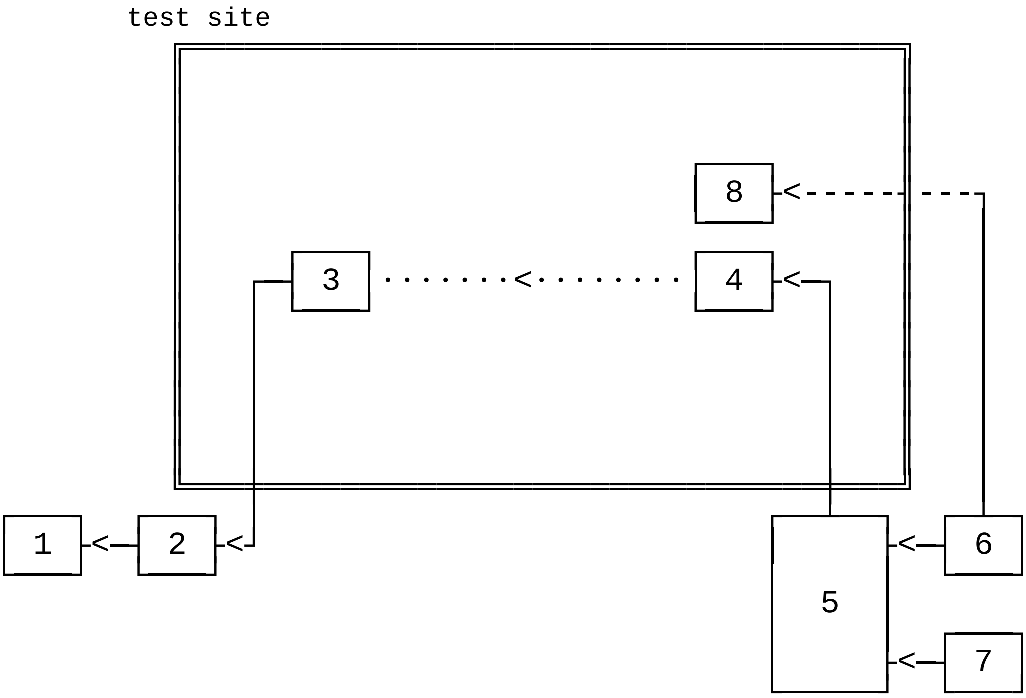
Hence:

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

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

For the calculations a) and b) above the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal (f_{lo}) applied to the 1st mixer of the receiver, the intermediate frequencies (f_{i1}, f_{i2} etc.), and the switching range (sr) of the receiver.

9.4.3 Measurement arrangement



1: Calling indicator
2: Photo detector/acoustic coupler
3: Receiver under test
4: Wideband test antenna
5: Combining network (used only when one antenna is used)
6: Signal generator A
7: Signal generator B
8: Test antenna for the wanted signal (see clause 9.4.3 e))

Figure 14: Measurement arrangement

a) A test site corresponding to that for the measurement of the average usable sensitivity shall be used (see clause 9.1).

b) The height of the wideband test antenna and the direction (angle) of the equipment under test shall be positioned as indicated in clause 9.1.4.

c) During the course of the measurement it may be necessary to radiate high powers in a broad frequency range, and care shall be taken to avoid the signals causing interference to existing services that may be operating in the neighbourhood.

d) In the presence of a reflective ground plane the height of the wideband test antenna has to be altered to optimize the reflections from the ground plane. This cannot be done simultaneously for two different frequencies.

   If vertical polarization is used, the ground floor reflection can be effectively eliminated by the use of an appropriate monopole located directly on the ground plane (rod antenna).

e) In case the wideband test antenna does not cover the necessary frequency range, alternatively two different and sufficiently decoupled antennas may be used.

f) The equipment under test shall be placed on the support in its standard position (see annex A) and in the reference direction on the support as indicated in clauses 9.1.2 and 9.1.4.

9.4.4 Method of the search

a) Two signal generators A and B shall be connected to the wideband test antenna via a combining network, where appropriate, or alternatively to two different antennas in accordance with clause 9.4.3 e).

The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation D-M3 (see clause 7.1).

The unwanted signal, represented by signal generator B, shall be modulated with a frequency of 400 Hz at a deviation of ±5 kHz.

b) Initially the unwanted signal shall be switched off.

The level of the wanted signal from generator A shall be adjusted to a level which is 3 dB above the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength, and by using the calibration in the procedure of clause 9.1.4.2 step d) (see clauses 9.1.5 and 9.1.4).

c) The unwanted signal shall then be switched on and its level shall be adjusted to provide a field strength which is at least 10 dB above the limit of the spurious response rejection (see clause 5.2.4) measured at the receiver location, even when on some types of test sites the level of the unwanted signal is varying considerably with the frequency due to ground reflections.

The frequency of the unwanted signal shall be varied in increments of 10 kHz over the limited frequency range and according to calculations outside of this frequency range (see clause 9.4.2 b)).

d) The normal test signal D-M3 shall be transmitted repeatedly whilst observing the responses.

e) If the successful response ratio is higher than 80 %, then no spurious response effects are detected and the measurement shall be continued on the next increment of frequency.

f) If three consecutive successful responses cannot be obtained then the level of the unwanted signal shall be reduced in steps of 1 dB until three successful responses are obtained.

g) In the case where a reflective ground floor is used the antenna height shall be varied at each change of unwanted signal level until three consecutive successful responses are obtained.

The test antenna need not be raised or lowered if a test site according to annex A, clause A.1.1 is used, or if the ground floor reflection can effectively be eliminated (see clause 9.4.3 d)).

h) The frequency of any spurious response detected during the search, and the antenna position and its height shall be recorded for the use in measurements in accordance with clause 9.4.5.

9.4.5 Method of measurement

At each frequency where a spurious response has been found, within and outside the limited frequency range, the measurement shall be performed as follows:

a) The measurement arrangement is identical to that in clauses 9.4.4 a) and g).

The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation D-M3 (see clause 7.1).

The unwanted signal, represented by signal generator B, shall be modulated with a frequency of 400 Hz with a deviation of 12 % of the channel separation (A-M3).

b) Initially the unwanted signal shall be switched off.

The level of the wanted signal from signal generator A shall be adjusted to a level which is 3 dB above the limit of the average usable sensitivity (see clause 9.1.4), for the category of equipment used (see clause 9.1.5), expressed in field strength when measured at the receiver location.

c) The unwanted signal from generator B shall then be switched on and its level shall be adjusted until a successful response ratio of less than 10 % is obtained.

d) The normal test signal D-M3 shall be transmitted repeatedly whilst observing in each case whether or not a successful response is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not obtained.

The procedure shall be continued until three consecutive successful responses are observed.

The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal D-M3 shall then be transmitted 20 times. In each case, if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a successful response is obtained the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained.

In this case the unwanted signal shall be increased by 1 dB and the new value noted.

No level of the unwanted signal level shall be noted unless preceded by a change in level.

The average of the values noted in steps d) and e) (which provides the level corresponding to the successful response ratio of 80 %) shall be recorded.

f) The unwanted signal shall be stepped up and down in increments of 20 % of the channel separation and steps d) and e) shall be repeated until the lowest average level recorded in step e) is obtained.

For each frequency the spurious response rejection shall be expressed, as the level in dBμV/m of the field strength of the unwanted signal at the receiver location, corresponding to the lowest value recorded during this step.

g) The measurement shall be repeated at all spurious response frequencies found during the search over the limited frequency range, clause 9.4.2, and at frequencies calculated for the remainder of the spurious response frequencies in the frequency range f_{Rx}/3,2 or 30 MHz, whichever is higher to 3,2 × f_{Rx}, where f_{Rx} is the nominal frequency of the receiver, with the antenna position and height noted in 9.1.2 j).

h) The spurious response rejection of the equipment under test shall be expressed as the level in dBμV/m of the field strength of the unwanted signal, at the receiver location, corresponding to the lowest value recorded in step f).

9.4.6 Limits

The spurious response rejection of the equipment shall be such that under the specified test conditions, the given degradation shall not be exceeded for levels of the unwanted signal up to:

- 75 dBμV/m for unwanted signal frequencies ≤ 68 MHz;
- (20 $\log_{10}$(f) + 38,3) dBμV/m for unwanted signal frequencies > 68 MHz, where f is the frequency in MHz.

9.5 Intermodulation response rejection

9.5.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

9.5.1 Definition

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

9.5.2 Method of measurement

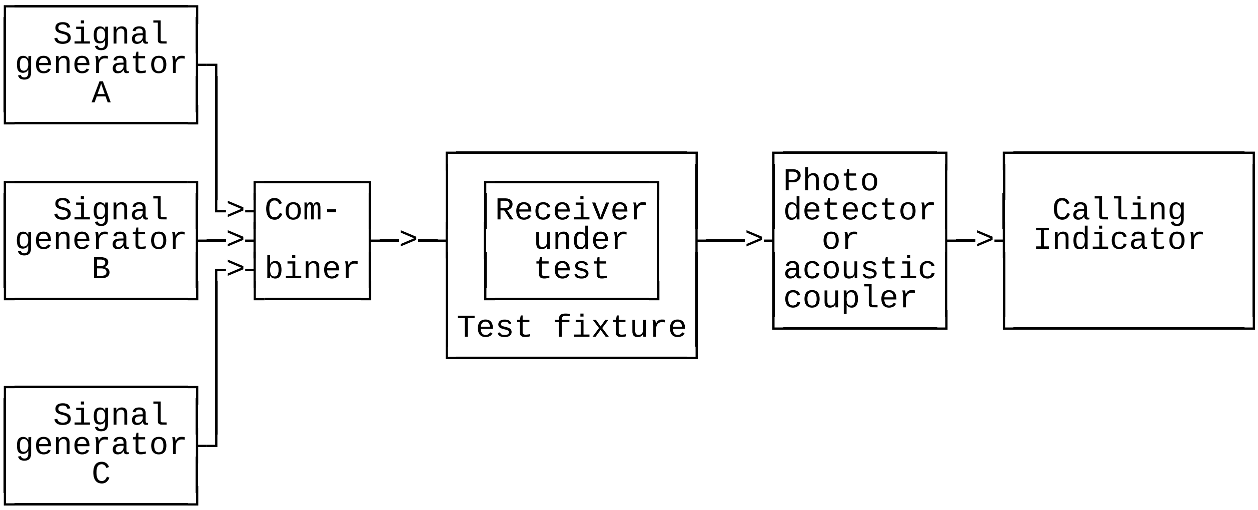


Figure 15: Measurement arrangement

a) The receiver shall be placed in the test fixture (see annex A, clause A.4).

Three signal generators, A, B and C shall be connected to the test fixture via a combining network.

The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation D-M3 (see clause 7.1).

The first unwanted signal, represented by signal generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the nominal frequency of the receiver.

The second unwanted signal, represented by signal generator C, shall be modulated with signal A-M3 (see clause 7.1) and adjusted to a frequency 100 kHz above the nominal frequency of the receiver.

b) Initially the unwanted signals shall be switched off.

The level of the wanted signal from generator A shall be adjusted to a level which is 3 dB above the level equivalent to the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength (see clauses 9.1.5 and 9.1.4).

c) The two unwanted signals from generators B and C shall then be switched on. Their levels shall be maintained equal and shall be adjusted until a successful response ratio of less than 10 % is obtained (see clause 9.3.2 e)).

d) The normal test signal D-M3 shall be transmitted repeatedly whilst observing in each case whether or not a successful response is obtained.

The levels of the unwanted signals shall be reduced by 2 dB for each occasion that a successful response is not obtained.

The procedure shall be continued until three consecutive successful responses are observed. The level of the input signals shall then be noted.

e) The level of the unwanted signals shall be increased by 1 dB and the new value noted. The normal test signal D-M3 shall then be transmitted 20 times. In each case, if a response is not obtained the level of the unwanted signals shall be reduced by 1 dB and the new value noted. If a successful response is obtained, the input level of the unwanted signals shall not be changed until three consecutive successful responses have been obtained.

In this case the level of the unwanted signals shall be increased by 1 dB and the new value noted.

No level of the unwanted signal shall be noted unless preceded by a change in level.

The average of the values noted in steps d) and e) (which provides the level corresponding to the successful response ratio of 80 %) shall be recorded.

f) For each configuration of the unwanted signals, the intermodulation response rejection shall be expressed as the ratio in dB of the average level recorded in step e) to the level of the wanted signal.

   It shall then be converted back into field strength of the unwanted signal at the receiver location and expressed in dBμV/m.

g) The measurement shall be repeated with the unwanted signal generator B at the frequency 50 kHz below that of the wanted signal and the frequency of the unwanted signal generator C at the frequency 100 kHz below that of the wanted signal.

h) The intermodulation response rejection of the equipment under test shall be expressed as the lower of the two values calculated in step f).

9.5.3 Limits

The intermodulation response rejection of the equipment shall be such that under the specified test conditions, the given degradation shall not be exceeded for levels of the unwanted signal up to:

- 70 dBμV/m for unwanted signal frequencies ≤ 68 MHz;
- (20 $\log_{10}$(f) + 33,3) dBμV/m for unwanted signal frequencies > 68 MHz, where f is the frequency in MHz.

9.6 Blocking or desensitization

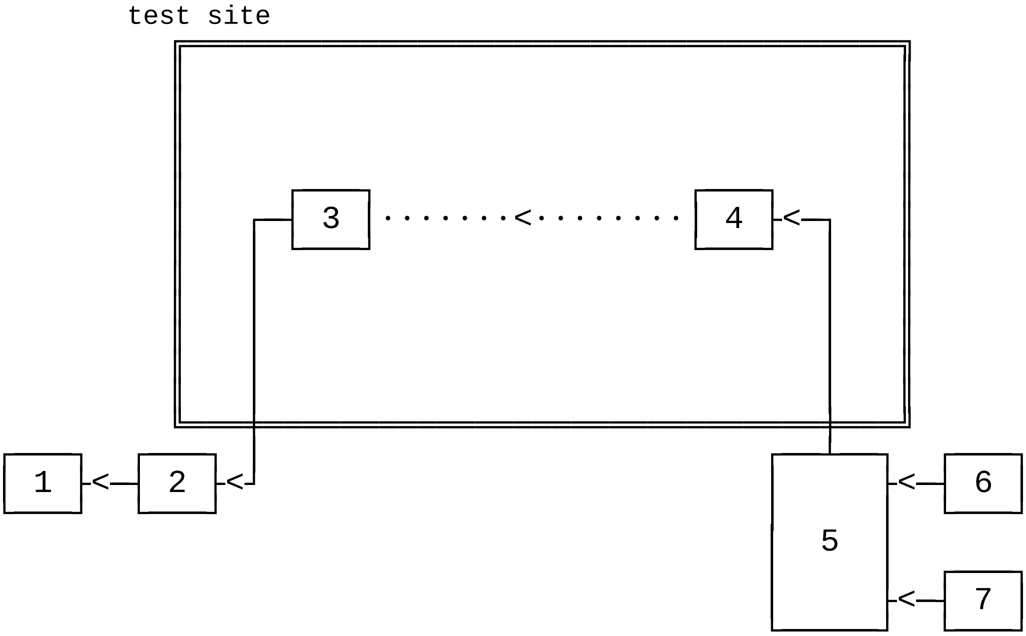
9.6.0 Applicability

This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

9.6.1 Definition

Blocking or desensitization is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal at any frequencies other than those of the spurious responses or adjacent channels.

9.6.2 Method of measurement



1: Calling indicator
2: Photo detector/acoustic coupler
3: Receiver under test
4: Wideband test antenna
5: Combining network
6: Signal generator A
7: Signal generator B

Figure 16: Measurement arrangement

A test site corresponding to that for the measurement of the average usable sensitivity shall be used (see clause 9.1).

The equipment under test shall be placed on the support in its standard position (see annex A,) and in the reference direction (see clause 9.1.2 j)) and the measurement shall be performed as follows.

a) Two signal generators A and B shall be connected to the wideband test antenna via a combining network.

   The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation (D-M3), (see clause 7.1).

   The unwanted signal, provided by signal generator B, shall be unmodulated and shall be at a frequency from 1 MHz to 10 MHz away from the nominal frequency of the receiver.

   For practical reasons the measurements shall be carried out at frequencies of the unwanted signal at approximately ±1 MHz, ±2 MHz, ±5 MHz and ±10 MHz, avoiding those frequencies at which spurious responses occur (see clause 9.4).

b) Initially the unwanted signal shall be switched off.

   The level of the wanted signal from generator A shall be adjusted to a level which is 3 dB above the level of the limit of the average usable sensitivity, for the category of equipment used, expressed as a field strength (see clause 9.1.4).

c) The unwanted signal shall then be switched on and its level shall be adjusted until a successful response ratio of less than 10 % is obtained.

d) The normal test signal D-M3 shall be transmitted repeatedly whilst observing in each case whether or not a successful response is obtained.

   The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not obtained.

The procedure shall be continued until three consecutive successful responses are observed.

The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal D-M3 shall then be transmitted 20 times. In each case if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a successful response is obtained the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained.

In this case the unwanted signal level shall be increased by 1 dB and the new value noted.

No level of the unwanted signal shall be noted unless preceded by a change in level.

The average of the values noted in steps d) and e) (which provides the level corresponding to the successful response ratio of 80 %) shall be recorded.

f) For each frequency, the blocking or desensitization shall be expressed as the level in dBuV/m of the field strength of the unwanted signal at the receiver location, corresponding to the average value recorded in step e).

g) The measurement shall be repeated for all the frequencies defined in step a).

h) The blocking or desensitization of the equipment under test shall be expressed as the level in dBμV/m of the field strength of the unwanted signal, at the receiver location, corresponding to the lowest value recorded in step f).

9.6.3 Limits

The blocking level, for any frequency within the specified ranges, shall be:

- ≥ 89 dBμV/m for unwanted signal frequencies ≤ 68 MHz;
- ≥ (20 $\log_{10}$(f) + 52,3) dBμV/m for unwanted signal frequencies > 68 MHz, where f is the frequency in MHz.

9.7 Receiver Spurious radiations

9.7.0 Applicability

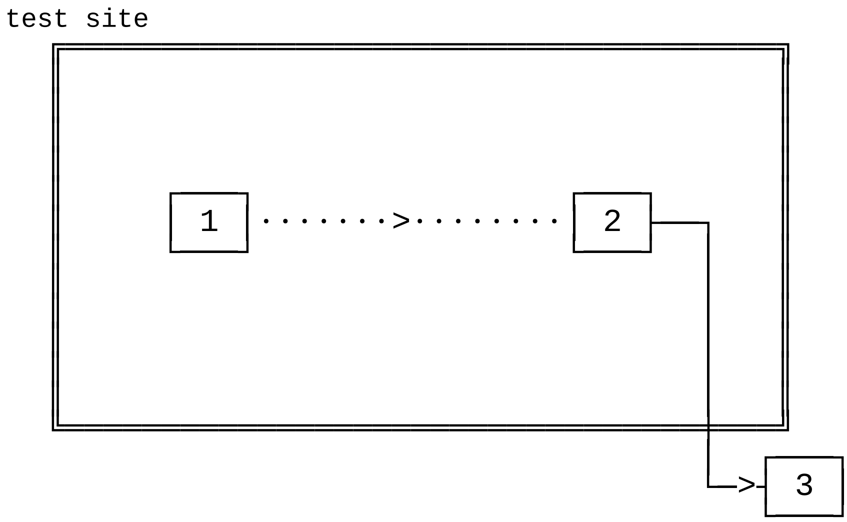
This measurement need not be carried out if this parameter has already been measured according to the requirements of ETSI EN 300 296 [3].

9.7.1 Definition

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

They are specified as the radiated power of any discrete signal.

9.7.2 Method of measurement



1: Receiver under test
2: Test antenna
3: Spectrum analyser or selective voltmeter (test receiver)

Figure 17: Measurement arrangement

a) A test site, which fulfils the requirements of the specified frequency range of this measurement, shall be used. The test antenna shall be orientated for vertical polarization and connected to a spectrum analyser or a selective voltmeter. The resolution bandwidth of the spectrum analyser or selective voltmeter shall be between 10 kHz and 120 kHz, set to a suitable value to correctly perform the measurement.

b) The receiver under test shall be placed on the support in its standard position (see annex A). The radiation of any spurious component shall be detected by the test antenna and spectrum analyser or selective voltmeter over the frequency range 30 MHz to 4 GHz. In addition, for equipment operating on frequencies above 470 MHz, measurements shall be repeated over the frequency range 4 GHz to 12,75 GHz.

   The frequency of each spurious component shall be recorded. If the test site is disturbed by radiation coming from outside, this qualitative search may be performed in a screened room with reduced distance between the transmitter and the test antenna.

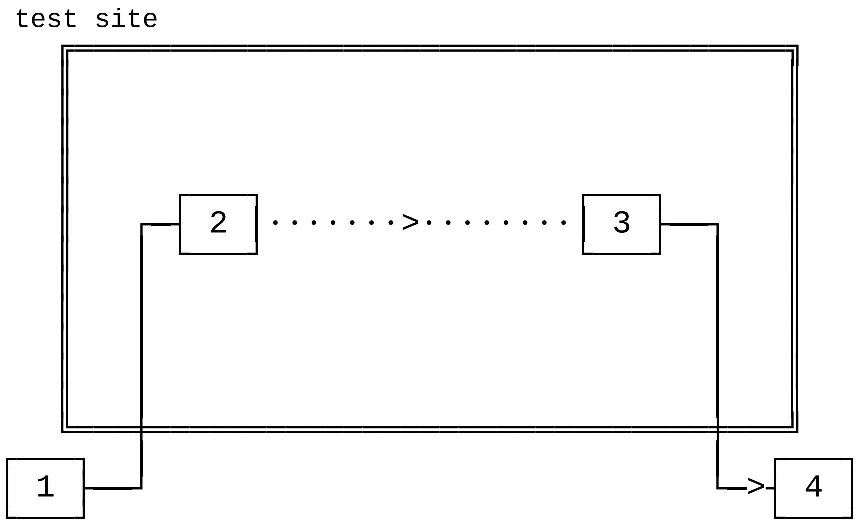
c) At each frequency at which a component has been detected, the spectrum analyser or selective voltmeter shall be tuned and the test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

   The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1 (i.e. an anechoic chamber).

d) The receiver shall be rotated up to 360° about a vertical axis, until a higher maximum signal is received.

e) The test antenna shall be raised or lowered again through the specified height range until a maximum is obtained. This level shall be recorded.

   The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1 (i.e. an anechoic chamber).



1: Signal generator
2: Substitution antenna
3: Test antenna
4: Spectrum analyser or selective voltmeter (test receiver)

Figure 18: Measurement arrangement

f) Using the measurement arrangement of figure 18 the substitution antenna shall replace the receiver antenna in the same position and in vertical polarization. It shall be connected to the signal generator.

g) For each frequency at which a component has been detected, the signal generator and spectrum analyser or selective voltmeter shall be tuned and the test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to annex A, clause A.1.1.

The level of the signal generator giving the same signal level on the spectrum analyser or selective voltmeter as in item e) above shall be recorded. This value, after correction due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna, is the radiated spurious component at this frequency.

h) Measurements b) to g) above shall be repeated with the test antenna orientated in horizontal polarization.

9.7.3 Limits

The power of any spurious radiation shall not exceed the values given in table 9.

Table 9: Radiated components

Frequency range	30 MHz to 1 GHz	above 1 to 12,75 GHz
Limit	2,0 nW (-57,0 dBm)	20,0 nW (-47,0 dBm)

10 Testing for compliance with technical requirements

10.1 Test conditions, power supply and ambient temperatures

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile which, as a minimum, shall be that specified in the test conditions contained in the present document.

As technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions as specified in the present document to give confidence of compliance for the affected technical requirements.

10.2 Interpretation of the measurement results

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

- the measured value related to the corresponding limit will be used to decide whether equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 1.

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

Table 10 is based on such expansion factors.

Table 10: Maximum values of absolute measurement uncertainties

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF Power (up to 160 W)	±0,75 dB
Radiated RF power	±6 dB
Adjacent channel power	±5 dB
Conducted RF power variations using a test fixture	±0,75 dB
Sensitivity	±3 dB
Two-signal measurement, radiated field	±6 dB
Three-signal measurement, text fixture	±3 dB
Radiated emission of the transmitter, valid up to 4 GHz	±6 dB
Radiated emission of receiver, valid up to 4 GHz	±6 dB
Transmitter attack time	±20 %
Transmitter release time	±20 %
Transmitter transient frequency (frequency difference)	±250 Hz
Valid up to 1 GHz for the RF parameters unless otherwise stated.	

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

Table 10 is based on such expansion factors.

The particular expansion factor used for the evaluation of the measurement uncertainty shall be stated.

ETSI TR 102 273 [i.2] provides further information concerning the usage of test sites.

Annex A (normative): Radiated measurement

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

A.1.0 General

This annex introduces three most commonly available test sites, an Anechoic Chamber, an Anechoic Chamber with a ground plane and an Open Area Test Site (OATS), which may be used for radiated tests. These test sites are generally referred to as free field test sites. Both absolute and relative measurements can be performed in these sites. Where absolute measurements are to be carried out, the chamber should be verified. A detailed verification procedure is described in ETSI TR 102 273 [i.2] relevant parts 2, 3 and 4.

NOTE: To ensure reproducibility and traceability of radiated measurements only these test sites should be used in measurements in accordance with the present document.

A.1.1 Anechoic chamber

An anechoic chamber is an enclosure, usually shielded, whose internal walls, floor and ceiling are covered with radio absorbing material, normally of the pyramidal urethane foam type. The chamber usually contains an antenna support at one end and a turntable at the other. A typical anechoic chamber is shown in figure A.1.

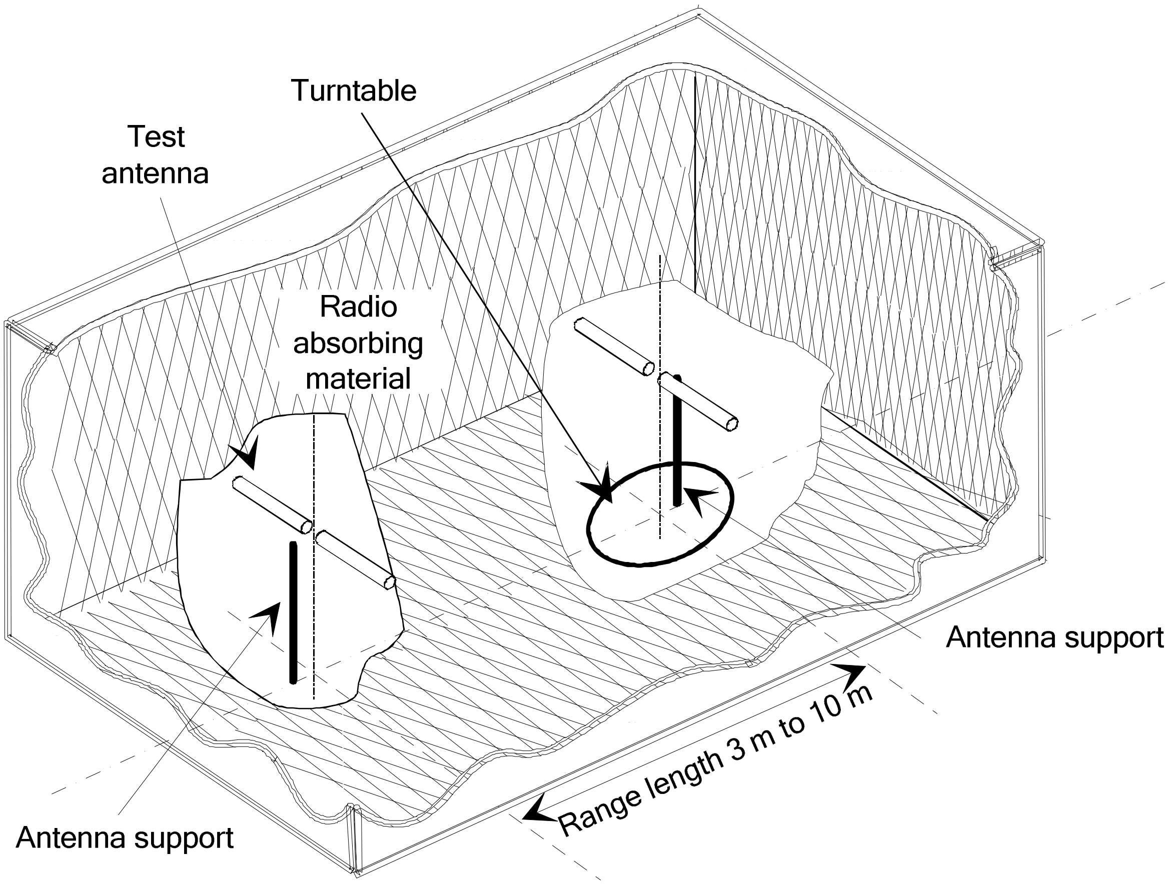


Figure A.1: A typical anechoic chamber

The chamber shielding and radio absorbing material work together to provide a controlled environment for testing purposes. This type of test chamber attempts to simulate free space conditions.

The shielding provides a test space, with reduced levels of interference from ambient signals and other outside effects, whilst the radio absorbing material minimizes unwanted reflections from the walls and ceiling which can influence the measurements. In practice it is relatively easy for shielding to provide high levels (80 dB to 140 dB) of ambient interference rejection, normally making ambient interference negligible.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the test sample (EUT) at a suitable height (e.g. 1 m) above the ground plane. The chamber shall be large enough to allow the measuring distance of at least 3 m or $2(d_1 + d_2)^2/\lambda$ (m), whichever is greater (see to clause A.2.5). The distance used in actual measurements shall be recorded with the test results.

The anechoic chamber generally has several advantages over other test facilities. There is minimal ambient interference, minimal floor, ceiling and wall reflections and it is independent of the weather. It does however have some disadvantages which include limited measuring distance and limited lower frequency usage due to the size of the pyramidal absorbers. To improve low frequency performance, a combination structure of ferrite tiles and urethane foam absorbers is commonly used.

All types of emission, sensitivity and immunity testing can be carried out within an Anechoic Chamber without limitation.

A.1.2 Anechoic chamber with a conductive ground plane

An anechoic chamber with a conductive ground plane is an enclosure, usually shielded, whose internal walls and ceiling are covered with radio absorbing material, normally of the pyramidal urethane foam type. The floor, which is metallic, is not covered and forms the ground plane. The chamber usually contains an antenna mast at one end and a turntable at the other. A typical anechoic chamber with a conductive ground plane is shown in figure A.2.

This type of test chamber attempts to simulate an ideal Open Area Test Site whose primary characteristic is a perfectly conducting ground plane of infinite extent.

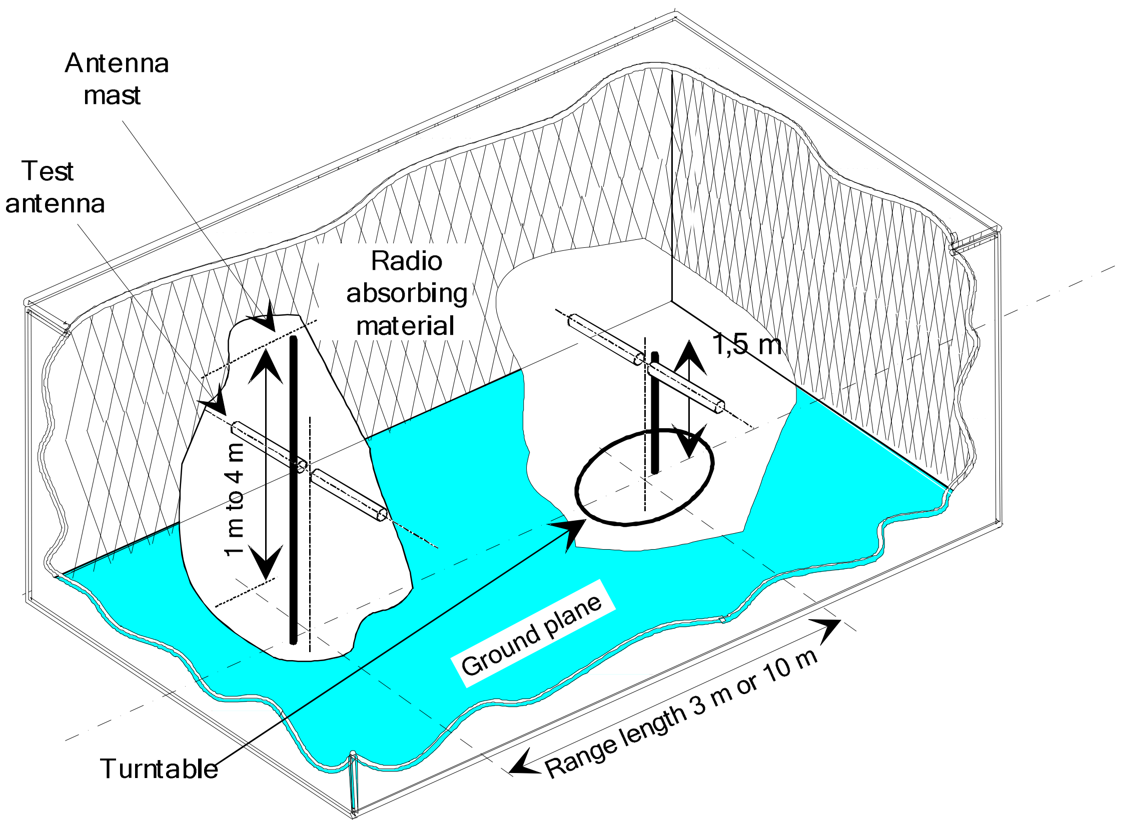


Figure A.2: A typical anechoic chamber with a conductive ground plane

In this facility the ground plane creates the wanted reflection path, such that the signal received by the receiving antenna is the sum of the signals from both the direct and reflected transmission paths. This creates a unique received signal level for each height of the transmitting antenna (or EUT) and the receiving antenna above the ground plane.

The antenna mast provides a variable height facility (from 1 to 4 metres) so that the position of the test antenna can be optimized for maximum coupled signal between antennas or between a EUT and the test antenna.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the test sample (EUT) at a specified height, usually 1,5 metres above the ground plane. The chamber shall be large enough to allow the measuring distance of at least 3 m or 2(d1 + d2)2/λ (m), whichever is greater (see clause A.2.5). The distance used in actual measurements shall be recorded with the test results.

Emission testing involves firstly "peaking" the field strength from the EUT by raising and lowering the receiving antenna on the mast (to obtain the maximum constructive interference of the direct and reflected signals from the EUT) and then rotating the turntable for a "peak" in the azimuth plane. At this height of the test antenna on the mast, the amplitude of the received signal is noted. Secondly the EUT is replaced by a substitution antenna (positioned at the EUT's phase or volume centre) which is connected to a signal generator. The signal is again "peaked" and the signal generator output adjusted until the level, noted in stage one, is again measured on the receiving device.

Receiver sensitivity tests over a ground plane also involve "peaking" the field strength by raising and lowering the test antenna on the mast to obtain the maximum constructive interference of the direct and reflected signals, this time using a measuring antenna which has been positioned where the phase or volume centre of the EUT will be during testing. A transform factor is derived. The test antenna remains at the same height for stage two, during which the measuring antenna is replaced by the EUT. The amplitude of the transmitted signal is reduced to determine the field strength level at which a specified response is obtained from the EUT.

A.1.3 Open Area Test Site (OATS)

An Open Area Test Site comprises a turntable at one end and an antenna mast of variable height at the other end above a ground plane which, in the ideal case, is perfectly conducting and of infinite extent. In practice, while good conductivity can be achieved, the ground plane size has to be limited. A typical Open Area Test Site is shown in figure A.3.

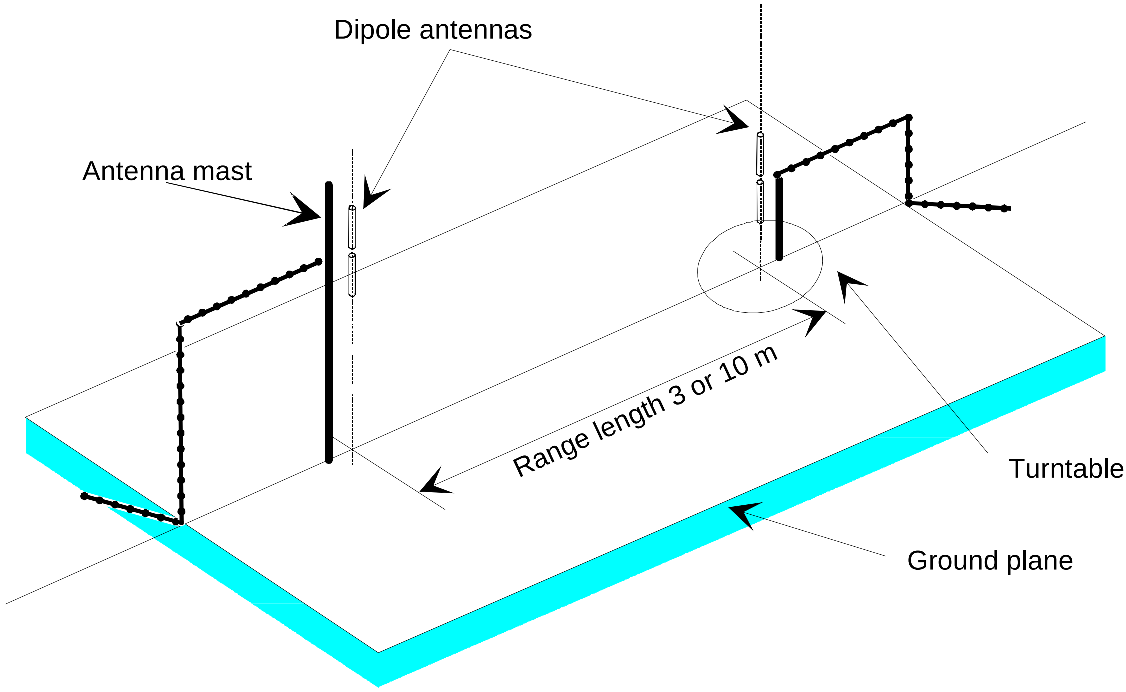


Figure A.3: A typical Open Area Test Site

The ground plane creates a wanted reflection path, such that the signal received by the receiving antenna is the sum of the signals received from the direct and reflected transmission paths. The phasing of these two signals creates a unique received level for each height of the transmitting antenna (or EUT) and the receiving antenna above the ground plane.

Site qualification concerning antenna positions, turntable, measurement distance and other arrangements are same as for anechoic chamber with a ground plane. In radiated measurements an OATS is also used by the same way as anechoic chamber with a ground plane.

Typical measuring arrangement common for ground plane test sites is presented in the figure A.4.

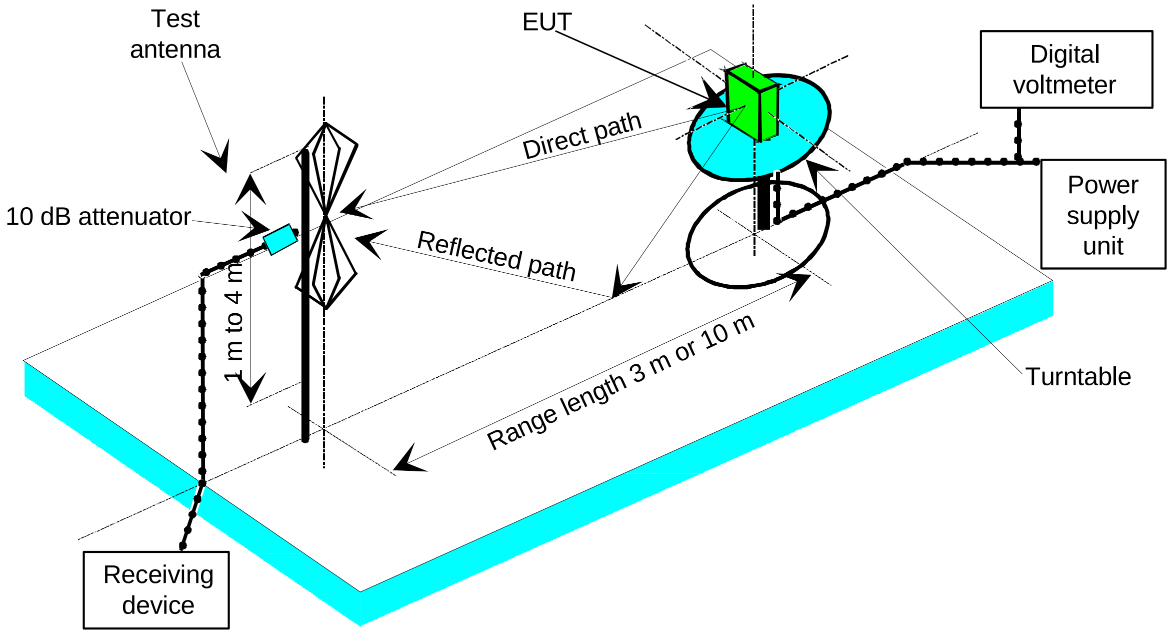


Figure A.4: Measuring arrangement on ground plane test site (OATS set-up for spurious emission testing)

A.1.4 Test antenna

A test antenna is always used in radiated test methods. In emission tests (i.e. frequency error, effective radiated power, spurious emissions and adjacent channel power) the test antenna is used to detect the field from the EUT in one stage of the measurement and from the substitution antenna in the other stage. When the test site is used for the measurement of receiver characteristics (i.e. sensitivity and various immunity parameters) the antenna is used as the transmitting device.

The test antenna should be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization which, on ground plane sites (i.e. Anechoic Chambers with ground planes and Open Area Test Sites), should additionally allow the height of its centre above the ground to be varied over the specified range (usually 1 to 4 metres).

In the frequency band 30 MHz to 1 000 MHz, dipole antennas (constructed in accordance with ANSI C63.5 [2]) are generally recommended. For frequencies of 80 MHz and above, the dipoles should have their arm lengths set for resonance at the frequency of test. Below 80 MHz, shortened arm lengths are recommended. For spurious emission testing, however, a combination of biconical antennas (commonly termed "bicones") and log periodic dipole array antennas (commonly termed "log periodics") could be used to cover the entire 30 MHz to 1 000 MHz band. Above 1 000 MHz, waveguide horns are recommended although, again, log periodics could be used.

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

A.1.5 Substitution antenna

The substitution antenna is used to replace the EUT for tests in which a transmitting parameter (i.e. frequency error, effective radiated power, spurious emissions and adjacent channel power) is being measured. For measurements in the frequency band 30 MHz to 1 000 MHz, the substitution antenna should be a dipole antenna (constructed in accordance with ANSI C63.5 [2]). For frequencies of 80 MHz and above, the dipoles should have their arm lengths set for resonance at the frequency of test. Below 80 MHz, shortened arm lengths are recommended. For measurements above 1 000 MHz, a waveguide horn is recommended. The centre of this antenna should coincide with either the phase centre or volume centre.

A.1.6 Measuring antenna

The measuring antenna is used in tests on a EUT in which a receiving parameter (i.e. sensitivity and various immunity tests) is being measured. Its purpose is to enable a measurement of the electric field strength in the vicinity of the EUT. For measurements in the frequency band 30 MHz to 1 000 MHz, the measuring antenna should be a dipole antenna (constructed in accordance with ANSI C63.5 [2]). For frequencies of 80 MHz and above, the dipoles should have their arm lengths set for resonance at the frequency of test. Below 80 MHz, shortened arm lengths are recommended. The centre of this antenna should coincide with either the phase centre or volume centre (as specified in the test method) of the EUT.

A.2 Guidance on the use of radiation test sites

A.2.0 General

This clause details procedures, test equipment arrangements and verification that should be carried out before any of the radiated test are undertaken. These schemes are common to all types of test sites described in annex A.

A.2.1 Verification of the test site

No test should be carried out on a test site which does not possess a valid certificate of verification. The verification procedures for the different types of test sites described in annex A (i.e. Anechoic Chamber, Anechoic Chamber with a ground plane and Open Area Test Site) are given in ETSI TR 102 273 [i.2] parts 2, 3 and 4, respectively.

A.2.2 Preparation of the EUT

The supplier should supply information about the EUT covering the operating frequency, polarization, supply voltage(s) and the reference face. Additional information, specific to the type of EUT should include, where relevant, carrier power, channel separation, whether different operating modes are available (e.g. high and low power modes) and if operation is continuous or is subject to a maximum test duty cycle (e.g. 1 minute on, 4 minutes off).

Where necessary, a mounting bracket of minimal size should be available for mounting the EUT on the turntable. This bracket should be made from low conductivity, low relative dielectric constant (i.e. less than 1,5) material(s) such as expanded polystyrene, balsawood, etc.

A.2.3 Power supplies to the EUT

All tests should be performed using power supplies wherever possible, including tests on EUT designed for battery-only use. In all cases, power leads should be connected to the EUT's supply terminals (and monitored with a digital voltmeter) but the battery should remain present, electrically isolated from the rest of the equipment, possibly by putting tape over its contacts.

The presence of these power cables can, however, affect the measured performance of the EUT. For this reason, they should be made to be "transparent" as far as the testing is concerned. This can be achieved by routing them away from the EUT and down to the either the screen, ground plane or facility wall (as appropriate) by the shortest possible paths. Precautions should be taken to minimize pick-up on these leads (e.g. the leads could be twisted together, loaded with ferrite beads at 0,15 metre spacing or otherwise loaded).

A.2.4 Volume control setting for analogue speech tests

Unless otherwise stated, in all receiver measurements for analogue speech the receiver volume control where possible, should be adjusted to give at least 50 % of the rated audio output power. In the case of stepped volume controls, the volume control should be set to the first step that provides an output power of at least 50 % of the rated audio output power. This control should not be readjusted between normal and extreme test conditions in tests.

A.2.5 Range length

The range length for all these types of test facility should be adequate to allow for testing in the far-field of the EUT i.e. it should be equal to or exceed:

$$\frac{2(d_1 + d_2)^2}{\lambda}$$

Where:

- d_1 is the largest dimension of the EUT/dipole after substitution (m);
- d_2 is the largest dimension of the test antenna (m);
- λ is the test frequency wavelength (m).

It should be noted that in the substitution part of this measurement, where both test and substitution antennas are half wavelength dipoles, this minimum range length for far-field testing would be:

$$2\lambda$$

It should be noted in test reports when either of these conditions is not met so that the additional measurement uncertainty can be incorporated into the results.

NOTE 1: For the fully anechoic chamber, no part of the volume of the EUT should, at any angle of rotation of the turntable, fall outside the "quiet zone" of the chamber at the nominal frequency of the test.

NOTE 2: The "quiet zone" is a volume within the Anechoic Chamber (without a ground plane) in which a specified performance has either been proven by test, or is guaranteed by the designer/supplier. The specified performance is usually the reflectivity of the absorbing panels or a directly related parameter (e.g. signal uniformity in amplitude and phase). It should be noted however that the defining levels of the quiet zone tend to vary.

NOTE 3: For the anechoic chamber with a ground plane, a full height scanning capability, i.e. 1 to 4 metres, should be available for which no part of the test antenna should come within 1 metre of the absorbing panels. For both types of Anechoic Chamber, the reflectivity of the absorbing panels should not be worse than -5 dB.

NOTE 4: For both the anechoic chamber with a ground plane and the Open Area Test Site, no part of any antenna should come within 0,25 metre of the ground plane at any time throughout the tests. Where any of these conditions cannot be met, measurements should not be carried out.

A.2.6 Site preparation

The cables for both ends of the test site should be routed horizontally away from the testing area for a minimum of 2 metres (unless, in the case both types of anechoic chamber, a back wall is reached) and then allowed to drop vertically and out through either the ground plane or screen (as appropriate) to the test equipment. Precautions should be taken to minimize pick up on these leads (e.g. dressing with ferrite beads, or other loading). The cables, their routing and dressing should be identical to the verification set-up.

NOTE: For ground reflection test sites (i.e. anechoic chambers with ground planes and Open Area Test Sites) which incorporate a cable drum with the antenna mast, the 2 metres requirement may be impossible to comply with.

Calibration data for all items of test equipment should be available and valid. For test, substitution and measuring antennas, the data should include gain relative to an isotropic radiator (or antenna factor) for the frequency of test. Also, the VSWR of the substitution and measuring antennas should be known.

The calibration data on all cables and attenuators should include insertion loss and VSWR throughout the entire frequency range of the tests. All VSWR and insertion loss figures should be recorded in the log book results sheet for the specific test.

Where correction factors/tables are required, these should be immediately available.

For all items of test equipment, the maximum errors they exhibit should be known along with the distribution of the error e.g.:

- cable loss: ±0,5 dB with a rectangular distribution;
- measuring receiver: 1,0 dB (standard deviation) signal level accuracy with a Gaussian error distribution.

At the start of measurements, system checks should be made on the items of test equipment used on the test site.

A.3 Coupling of signals

A.3.1 General

The presence of leads in the radiated field may cause a disturbance of that field and lead to additional measurement uncertainty. These disturbances can be minimized by using suitable coupling methods, offering signal isolation and minimum field disturbance (e.g. optical and acoustic coupling).

A.3.2 Data signals

Isolation can be provided by the use of optical, ultrasonic or infra-red means. Field disturbance can be minimized by using a suitable fibre optic connection. ultrasonic or infra-red radiated connections require suitable measures for the minimization of ambient noise.

A.3.3 Speech and analogue signals

A.3.3.0 General

Where an audio output socket is not available an acoustic coupler should be used.

When using the acoustic coupler, care should be exercised that possible ambient noise does not influence the test result.

A.3.3.1 Acoustic coupler description

The acoustic coupler comprises a plastic funnel, an acoustic pipe and a microphone with a suitable amplifier. The materials used to fabricate the funnel and pipe should be of low conductivity and of low relative dielectric constant (i.e. less than 1,5).

- The acoustic pipe should be long enough to reach from the EUT to the microphone which should be located in a position that will not disturb the RF field. The acoustic pipe should have an inner diameter of about 6 mm and a wall thickness of about 1,5 mm and should be sufficiently flexible so as not to hinder the rotation of the turntable.
- The plastic funnel should have a diameter appropriate to the size of the loudspeaker in the EUT, with soft foam rubber glued to its edge, it should be fitted to one end of the acoustic pipe and the microphone should be fitted to the other end. It is very important to fix the centre of the funnel in a reproducible position relative to the EUT, since the position of the centre has a strong influence on the frequency response that will be measured. This can be achieved by placing the EUT in a close fitting acoustic mounting jig, supplied by the supplier, of which the funnel is an integral part.
- The microphone should have a response characteristic flat within 1 dB over a frequency range of 50 Hz to 20 kHz, a linear dynamic range of at least 50 dB. The sensitivity of the microphone and the receiver audio output level should be suitable to measure a signal to noise ratio of at least 40 dB at the nominal audio output level of the EUT. Its size should be sufficiently small to couple to the acoustic pipe.
- The frequency correcting network should correct the frequency response of the acoustic coupler so that the acoustic SINAD measurement is valid (see IEC 60489-3 [i.3], appendix F).

A.3.3.2 Calibration

The aim of the calibration of the acoustic coupler is to determine the acoustic SINAD ratio which is equivalent to the SINAD ratio at the receiver output.

A.4 Test fixture

A.4.1 Description

The test fixture is only needed for the assessment of integral antenna equipment.

The test fixture is a radio frequency coupling device associated with an integral antenna equipment 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 the conducted measurement methods. Only relative measurements may be performed and only those at or near frequencies for which the test fixture has been calibrated.

In addition, the test fixture may provide:

a) a connection to an external power supply;

b) in the case of assessment of speech equipment, an audio interface either by direct connection or by an acoustic coupler.

In the case of non-speech equipment, the test fixture can also provide the suitable coupling means e.g. for the data output.

The test fixture shall normally be provided by the supplier.

The performance characteristics of the test fixture shall conform to the following basic parameters:

a) the coupling loss shall not be greater than 30 dB;

b) a coupling loss variation over the frequency range used in the measurement which does not exceed 2 dB;

c) circuitry associated with the RF coupling shall contain no active or non-linear devices;

d) the VSWR at the 50 Ω socket shall not be more than 1,5 over the frequency range of the measurements;

e) 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;

f) the coupling loss shall remain substantially constant when the environmental conditions are varied.

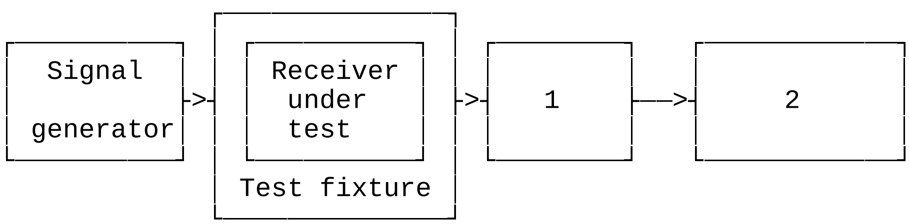
The characteristics and calibration shall be recorded.

A.4.2 Calibration

The calibration of the test fixture establishes a relationship between the output of the signal generator and the field strength applied to the equipment placed in the test fixture.

The calibration is valid only at a given frequency and for a given polarization of the reference field.

The actual set-up used depends on the type of the equipment (e.g. data, speech, etc.).



1) Coupling device, e.g. AF load/acoustic coupler (in the case of speech equipment)
2) Device for assessing the performance, e.g. distortion factor/audio level meter, BER measuring device etc.

Figure A.5: Measuring arrangement for calibration

Method of calibration:

a) Measure the sensitivity expressed as a field strength, as specified in the present document and note the value of this field strength in dBμV/m and the polarization used.

b) Place the receiver in the test fixture which is connected to the signal generator. The level of the signal generator producing:

- a SINAD of 20 dB;
- a bit error ratio of 0,01; or
- a message acceptance ratio of 80 %, as appropriate, shall be noted.

The calibration of the test fixture is the relationship between the field strength in dBμV/m and the signal generator level in dBμV emf. This relationship is expected to be linear.

A.4.3 Mode of use

The test fixture may be used to facilitate some of the measurements in the case of equipment having an integral antenna.

It is used in particularly for the measurement of the radiated carrier power and usable sensitivity expressed as a field strength under the extreme conditions.

For the transmitter measurements calibration is not required as relative measuring methods are used.

For the receiver measurements calibration is necessary as absolute measurements are used.

To apply the specified wanted signal level expressed in field strength, convert it into the signal generator level (emf) using the calibration of the test fixture. Apply this value to the signal generator.

Annex B (normative): Specification for some particular measurement arrangements

B.1 Power measuring receiver specification

B.1.0 General

The power measuring receiver is used for the measurement of the transmitter adjacent channel power. It consists of a mixer and oscillator, an IF filter, an amplifier, a variable attenuator and a level indicator as shown below (figure B.1).

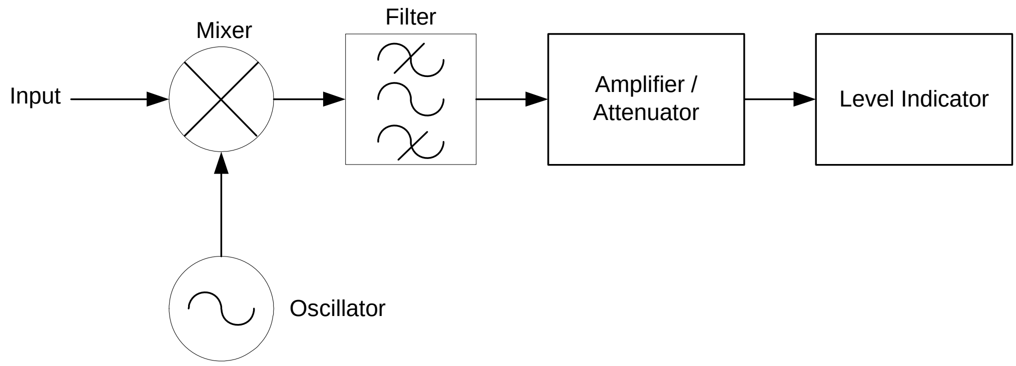


Figure B.1: Power measuring receiver

Instead of the Variable attenuator with the rms value indicator it is also possible to use a rms voltmeter calibrated in dB. The technical characteristics of the power measuring receiver are given in clauses B.1.1 to B.1.5.

B.1.1 IF filter

The IF filter shall be within the limits of the selectivity characteristic of figure B.2.

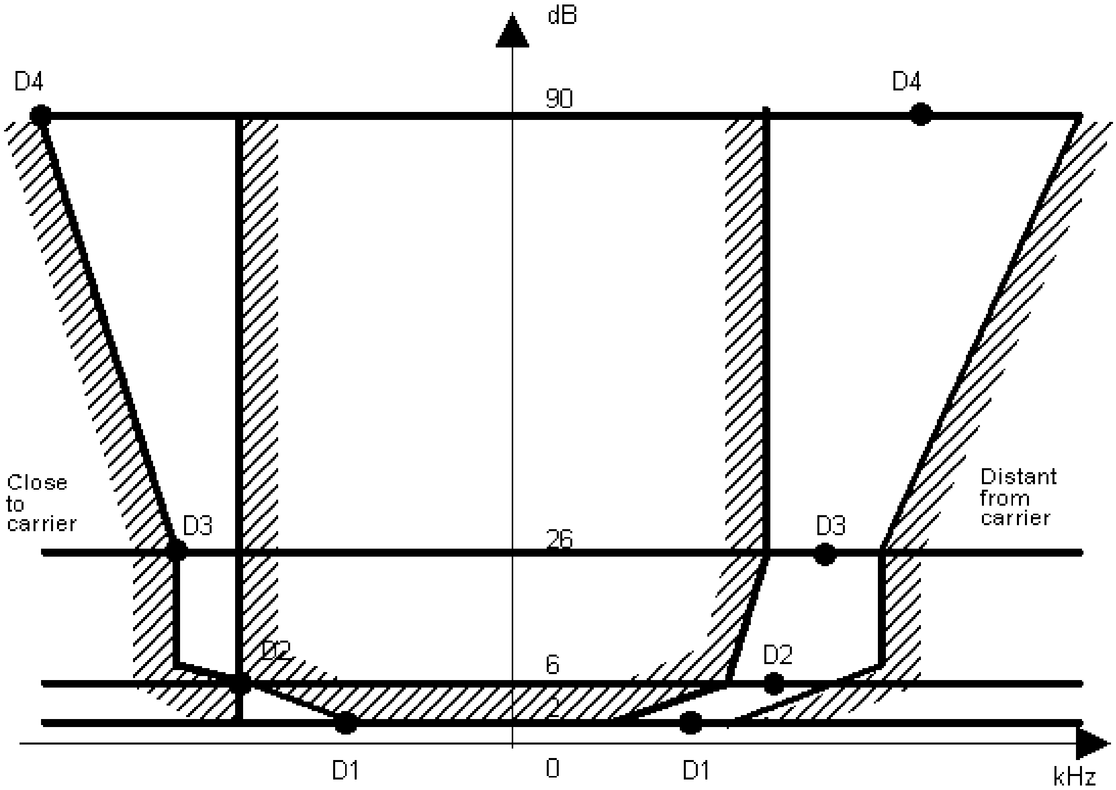


Figure B.2: IF filter

Depending on the channel separation, the selectivity characteristic shall keep the frequency separations from the nominal centre frequency of the adjacent channel as stated in table B.1.

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**
12,5	3	4,25	5,5	9,5
20	4	7,0	8,25	12,25
25	5	8,0	9,25	13,25

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

Table B.2: Attenuation points close to carrier

Channel separation (kHz)	Tolerances range (kHz)			
	D1	**D2**	**D3**	**D4**
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
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 greater than or equal to 90 dB.

B.1.2 Attenuation indicator

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

B.1.3 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 12,5 kHz, referred to the carrier of the oscillator.

B.2 Spectrum analyser specification

B.2.1 Adjacent and alternate channel power measurement

The characteristics of the spectrum analyser shall meet at least the following requirements:

- the reading accuracy of the frequency marker shall be within ±100 Hz;
- the accuracy of relative amplitude measurements shall be within ±3,5 dB.

It shall be possible to adjust the spectrum analyser to allow the separation on its screen of two equal amplitude components with a frequency difference of 200 Hz.

For statistically distributed modulations, the spectrum analyser and the integrating device (when appropriate) needs to allow determination of the power spectral density (energy per time and bandwidth), which has to be integrated over the bandwidth in question. It shall be possible to sum the effective power of all discrete components, the spectral power density and the noise power in the selected bandwidth and to measure this as a ratio relative to the carrier power.

The spectrum analyser should have a dynamic range greater than 90 dB and the average phase noise in the adjacent channels shall be such that measurement of adjacent channel power is not limited by phase noise. In order to confirm this, the selected measurement technique for clause 7.4.2 shall be used to measure the adjacent channel power with a CW signal source with phase noise of less than -120 dBc/Hz in the centre of the adjacent channel. The following performance shall be achieved:

- the maximum adjacent channel power observed with these conditions shall not exceed -70 dBc;
- the maximum alternate channel power measured with these conditions shall not exceed -80 dBc.

NOTE: A resolution bandwidth of 500 Hz may be used for this measurement as an alternative to the usual 100 Hz to reduce measurement time.

B.2.2 Unwanted emissions measurement

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 the wanted signal.

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

For statistically distributed modulations, the spectrum analyser and the integrating device (when appropriate) shall allow determination of the real spectral power density (energy per time and bandwidth), which has to be integrated over the bandwidth in question.

B.3 Integrating and power summing device

The integrating and power summing device is connected to the video output of the spectrum analyser, referred to in clause B.2.

It shall be possible to sum the effective power of all discrete components, the spectral power density and the noise power in the selected bandwidth and to measure this as a ratio relative to the carrier power.

Annex C (normative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared in reply to the Commission's standardisation request Commission Implementing Decision C(2015) 5376 final of 04.08.2015 to provide a means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment.

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table C.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table C.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 300 341 The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.5]				
Requirement			**Requirement Conditionality**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**
1	Transmitter frequency error	8.1	C	Not required if already tested to ETSI EN 300 296 [3]
2	Transmitter effective radiated power	8.2	C	Not required if already tested to ETSI EN 300 296 [3]
3	Transmitter adjacent channel power	8.3	U	
4	Transmitter radiated spurious emissions	8.4	C	Not required if performance is evaluated as part of parallel testing to ETSI EN 300 296 [3]
5	Transmitter transient frequency behaviour	8.5	C	Not required if already tested to ETSI EN 300 296 [3]
6	Receiver average useable sensitivity, (responses)	9.1	U	
7	Receiver co-channel rejection	9.2	C	Not required if already tested to ETSI EN 300 296 [3]
8	Receiver adjacent channel selectivity	9.3	C	Not required if already tested to ETSI EN 300 296 [3]
11	Receiver spurious response rejection	9.4	C	Not required if already tested to ETSI EN 300 296 [3]
12	Receiver inter-modulation response rejection	9.5	C	Not required if already tested to ETSI EN 300 296 [3]
13	Receiver blocking or desensitization	9.6	C	Not required if already tested to ETSI EN 300 296 [3]
14	Receiver spurious radiations	9.7	C	Not required if already tested to ETSI EN 300 296 [3]

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement shall be unconditionally applicable (U) or is conditional upon the manufacturers claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement shall or shall not be applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

History

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