

ETSI EN 300 224 V2.1.1 (2017-06)



HARMONISED EUROPEAN STANDARD

**Land Mobile Service;
Radio Equipment for use in a Paging Service
operating within the frequency range 25 MHz - 470 MHz;
Harmonised Standard covering the essential requirements
of article 3.2 of Directive 2014/53/EU**

Reference

REN/ERM-TG30-315

Keywords

harmonised standard, paging, radio, testing

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Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] to provide one voluntary 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 and repealing Directive 1999/5/EC [i.1].

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 A.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.

National transposition dates	
Date of adoption of this EN:	26 June 2017
Date of latest announcement of this EN (doa):	30 September 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2018
Date of withdrawal of any conflicting National Standard (dow):	31 March 2019

Modal verbs terminology

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

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1 Scope

The present document applies to on-site and wide area paging equipment, operating in the frequency range of 25 MHz to 470 MHz.

An on-site paging system is a privately owned and operated wireless communication system, used in a restricted and predefined area, with the primary function to alert and/or inform ambulant people. The air interface of the system, using a single radio channel, comprises at least one transmitter. The system may be extended to include a return, or talk-back frequency. Mainly used for call acknowledgement, this frequency may also be used to supply some of the features of a mobile radio service, or other two-way radio services, without the need to use a separate system.

Covering a larger geographical area, a wide-area system is typically associated with large organizations such as emergency services and may include additional radio facilities and utilize different a frequency for return messaging, which is outside the scope of the present document. These features should be tested against the relevant standard.

The present document specifies technical characteristics and methods of measurements for the following equipment types:

- 1) base station transmitters and transcoders, with or without an external 50 Ω antenna connector;
- 2) base station receivers, with a permanent 50 Ω connector;
- 3) paging receiver, with or without an external 50 Ω antenna connector.

These radio equipment types are capable of operating in all or any part of the frequency bands given in table 1.

Table 1: Radiocommunications service frequency bands

Radiocommunications service frequency bands	
Transmit	25 MHz to 470 MHz
Receive	25 MHz to 470 MHz
NOTE: Frequencies and frequency bands, used for on-site paging equipment, are not harmonised throughout the community. The frequency band 47 MHz to 47,25 MHz and operating frequencies or operating bands within 440 MHz to 470 MHz, are recommended by CEPT/ECC in Report 25 [i.5].	

The existence of a Harmonised Standard does not imply the availability of the above frequency spectrum for the particular types of equipment covered by the present document.

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU under the conditions identified in annex A and 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*" [i.1].

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.1] may apply to equipment within the scope of the present document.

2 References

2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version applies.

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

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

Not applicable.

2.2 Informative references

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

- [i.1] 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.2] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 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.
- [i.3] ETSI EN 300 793 (V1.1.1): "Electromagnetic compatibility and Radio Spectrum Matters (ERM); Land mobile service; Presentation of equipment for type testing".
- [i.4] ETSI TS 103 052 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".
- [i.5] CEPT/ERC Report 25 (June 2016): "The European Table of Frequency Allocations and Applications in the Frequency Range 8.3 kHz to 3000 GHz".
- [i.6] Recommendation ITU-T O.41 (1994): "Psophometer for use on telephone-type circuits".
- [i.7] 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".
- [i.8] IEC 60489-3: "Radio equipment used in mobile services. Methods of measurement for receivers for A3E or F3E emissions".
- [i.9] ANSI C63.5 (2006): "American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electro Magnetic Interference".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the Radio Equipment Directive [i.1] and the following apply:

50 Ω : 50 Ohm non-reactive impedance

angle/constant envelope modulation: either phase or frequency modulation, with or without pre-emphasis

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

base station: transmitter and/or receiver intended for use in a fixed location

coded messages: messages transmitted to a paging receiver via coded signals

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

integral antenna: antenna designed as an indispensable part of the equipment, with or without the use of an antenna connector

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

Low Frequency (LF): frequency range from 30 kHz to 300 kHz

paging receiver: equipment for the reception and decoding of paging transmissions; either fixed or portable

pocket unit: pocket size equipment fitted with an integral antenna, carried on a person or held in the hand

preamble facility: signal needed in a system in which a battery saving system is used, in order to activate and prepare the receivers for the calls to come

psophometric weighting network: As described in Recommendation ITU-T O.41 [i.6].

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

SINAD: SND/ND ratio

SINAD Meter: measurement instrument used to measure SND/ND using a band-stop filter

transcoder: transmitter and encoder combined in a single housing and normally operated in a fixed location indoors

3.2 Symbols

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

Hz	Hertz
kHz	kilohertz
MHz	Megahertz
V	Volt
W	Watt

3.3 Abbreviations

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

AM	Amplitude Modulation
emf	electromotive force
EUT	Equipment Under Test
IF	Intermediate Frequency
MPFD	Maximum Permissible Frequency Deviation
OATS	Open Area Test Site
PTT	Push To Talk
RF	Radio Frequency
rms	root-mean-squared
SND/ND	(Signal + Noise And Distortion)/(Noise + Distortion) ratio
Tx	Transmitter
VOX	Voice Operated Switch
VSWR	Voltage Standing Wave Ratio

4 Testing for compliance with technical requirements

4.1 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 manufacturer but as a minimum, shall be that specified in the test conditions contained in the present document. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times, when operating within the boundary limits of the declared operational environmental profile.

4.2 Choice of model for testing

4.2.0 General

Stand-alone equipment should be complete with any ancillary equipment needed for testing.

If an equipment has several optional features considered not to affect the RF parameters, then the tests need only to be performed on the equipment configured with the combination of features considered to be the most complex.

Where practicable, equipment to be tested should provide a 50 Ω connector for conducted RF power level measurements.

In the case of integral antenna equipment, if the equipment does not have an internal permanent connector, then it is permissible to use a second sample of the equipment with a temporary antenna connector fitted to facilitate testing. Any such modified samples shall not be used for any radiated measurements.

The performance of the equipment to be tested shall be representative of the performance of the corresponding production model.

NOTE: Guidance may be found in ETSI EN 300 793 [i.3].

4.2.1 Auxiliary test equipment

All necessary auxiliary test equipment, setting up instructions and other product information should be available.

4.3 Mechanical and electrical design

4.3.1 General

The equipment should be designed, constructed and manufactured in accordance with good engineering practice, and with the aim of minimizing harmful interference to other equipment and services.

4.3.2 Controls

Those controls, which if maladjusted might increase the interfering potentialities of the equipment, should not be accessible for adjustment by the user.

4.3.3 Transmitter shut-off facility

When a timer for an automatic shut-off facility is operative, at the moment of the time-out, the transmitter should automatically be switched off (the re-activation of the transmitter shall reset the timer).

A shut-off facility should be inoperative for the duration of the measurements, unless it has to remain operative to protect the equipment. If the shut-off facility is left operative, the status of the equipment should be indicated.

5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

Type tests shall be made under normal operational conditions and, where stated, under extreme conditions. The test conditions and procedures shall be as specified in clauses 5.2 and 5.3.

5.2 Normal operational test conditions

5.2.1 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.

5.2.2 Normal test power source

a) Mains supply:

- the normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of type testing to the present document, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed;
- the frequency of the test power source corresponding to the ac mains shall be between 49 Hz and 51 Hz.

b) 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 and approved by the test authority;
- such values shall be stated in the test report;
- in pocket equipment with an integral antenna, the battery shall not be replaced with an external power source when making radiating measurements, because this external power source could influence the test results.

5.3 Extreme test conditions

5.3.1 Procedure for tests at extreme temperatures

Before measurements are made the equipment shall have reached thermal balance in the test chamber. The equipment shall be switched to stand-by during the temperature stabilizing period.

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

- a) Procedure for equipment designed for continuous operation:
 - if the manufacturer states that the equipment is designed for continuous operation, the procedure shall be as follows:
 - before tests at the upper temperature, the equipment shall be placed in the test chamber and left until thermal balance is attained. The equipment shall then be switched on in the transmit condition for a period of half an hour, after which the equipment shall meet the specified requirements. For tests at the lower temperatures, the equipment shall be left in the test chamber until thermal balance is attained, after which the equipment shall meet the specified requirements.
- b) Procedure for equipment designed for intermittent operation:
 - if the applicant states that the equipment is designed for intermittent operation, the test procedure shall be as follows:
 - before tests at the upper extreme temperature are made, the equipment shall be placed in the test chamber and left until thermal balance is attained in the test chamber;
 - the equipment shall then either:
 - transmit "on" and "off", according to the duty cycle as declared by the applicant, for a period of 5 minutes; or,
 - if the "on" period as declared by the applicant exceeds one minute, transmit in the "on" condition for a period not exceeding one minute, followed by a period in the "off" or "standby" mode for four minutes, after which the equipment shall meet the specified requirements.

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

5.3.2 Extreme temperature limits

For tests at extreme temperatures, measurements shall be made in accordance with procedures specified in clause 5.3.1 over an ambient temperature range of:

- Base station equipment: -20 °C to +55 °C;
- Transcoder used in temperature-controlled environments: -10 °C to +55 °C;
- Pocket and fixed paging receiver unit equipment: -10 °C to +55 °C.

5.3.3 Extreme test power source

- a) Mains voltage:
 - the extreme source voltages for equipment to be connected to an ac mains source, shall be the nominal mains voltage $\pm 10\%$.
- b) Battery power source:
 - when the equipment is intended for operation from battery power sources, the extreme voltages shall be as follows:
 - the end point voltages indicated by the battery status indicator of the unit under test;

- where the equipment does not have a battery status indicator, and the manufacturer has not declared the end point voltages, the following end point voltages shall be used:
 - For Leclanché, Nickel Metal-Hydride, or Lithium type of battery: 0,85 times the nominal voltage of the battery. No upper extreme test voltages apply.
 - 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.

5.3.4 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 5.2.2 and 5.3.3. The internal impedance of the test power source shall be low enough to ensure that its effect on the test results is negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

If power to the equipment is provided from an external power source, the test voltages shall be those measured at the point of connection of the power cable to the equipment.

In battery operated equipment, the test power source shall be applied as close to the equipment battery supply terminals as practicable.

During the tests, the test power source voltages shall be maintained within a tolerance ≤ 1 % relative to the voltage at the beginning of each test. The value of this tolerance is critical for certain measurements. Using a smaller tolerance provides a better uncertainty value for these measurements.

6 Electrical test conditions

6.1 Normal test signals and test modulation

6.1.0 General

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

6.1.1 Normal test signals for analogue speech

These test signals are defined as:

A-M1: a 1 000 Hz tone;

A-M2: a 1 250 Hz tone.

The normal level of the test signals A-M1 and A-M2 shall produce a deviation of 12 % of the channel separation or any lower value as declared by the manufacturer as the normal operating level.

6.1.2 Normal test signals for data

This test signal is defined as:

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

The normal level of the test signal D-M3 shall produce a deviation of 20 % of the channel separation, or any other value as declared by the manufacturer as the normal operating level.

For test purposes if special equipment is required to generate or indicate correct acceptance of the messages, it shall be supplied by the manufacturer.

- A-M3: a 400 Hz tone, at a level which produces a deviation of 12 % of the channel separation. This signal is used as an unwanted signal for analogue and digital measurements.

6.2 Artificial antenna/load

Tests shall be carried out using an artificial antenna/load, which shall be a substantially non-reactive, non-radiating load of 50 Ω , connected to the antenna connector.

6.3 Test fixture for transmitters with an integral antenna

With equipment intended for use with an integral antenna and not equipped with a 50 Ω output connection, the manufacturer may be required to supply a test fixture. This test fixture is a radio frequency coupling device for coupling the integral antenna to a 50 Ω radio frequency terminal, at the working frequencies of the equipment under test. This allows certain measurements to be performed using conducted measuring methods. Only relative measurements may be performed.

If applicable, the test fixture shall provide:

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

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

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

6.4 Test site and general arrangement for measurements involving the use of radiated fields

Test sites shall be open air.

The term "open air" should be understood from an electromagnetic point of view. Such a test site may be "outdoor" (really in open air) or alternatively "indoor" with walls and ceiling transparent to the radio waves at the frequencies considered.

An alternative indoor test site is an anechoic room.

For guidance see annex A. Descriptions of the radiated measurement arrangements are included in annex A.

7 Transmitter

7.0 General

In the case of equipment with variable output power, all measurements shall be made using the highest power level. The equipment shall be adjusted to the lowest output power setting and the measurements repeated in clauses 7.2 (carrier power), 7.3 (adjacent channel power), 7.5 (spurious emissions) and 7.6 (transmitter transient behaviour).

When making transmitter tests on equipment designed for intermittent operation, the maximum transmit time and duty cycle, as declared by the manufacturer, shall not be exceeded. The maximum transmit time shall be noted in the test report.

7.1 Frequency error

7.1.0 General

The test in this clause, or the test in clause 7.3.2 under extreme conditions, shall be carried out.

At the time of submission of the equipment for test, the applicant shall declare which test method shall be applicable for the test sample equipment supplied.

The equipment under test shall fulfil the requirements of the declared test.

7.1.1 Definition

The frequency error of the transmitter is the difference between the unmodulated carrier frequency and its nominal value.

7.1.2 Method of measurement

The carrier frequency shall be measured by one of the following methods, depending on whether the transmitter is capable of providing an unmodulated carrier.

- a) Method of measurement where an unmodulated carrier is available:
 - The carrier frequency shall be measured in the absence of modulation, with the transmitter connected to an artificial load. A transmitter without a 50 Ω connector shall be placed in the test fixture (see clause 6.3) connected to an artificial load. The measurement shall be made under normal test conditions and extreme test conditions (extreme temperature and supply voltage simultaneously).
- b) Method of measurement where it is not possible to obtain an unmodulated carrier:
 - 1) the transmitter output shall be connected to an artificial load. A transmitter without a 50 Ω connector shall be placed in the test fixture (see clause 6.3) connected to an artificial load;
 - 2) the emission shall be monitored by a frequency counter and the carrier frequency shall be measured with the transmitter set to continuously produce the carrier frequency representing the "space" condition;
 - 3) the measurement shall be repeated with the transmitter set to continuously produce the carrier frequency representing the "mark" condition;
 - 4) the unmodulated carrier frequency shall be obtained as the arithmetic mean of the two frequencies measured above.

The measurements shall be made under normal test conditions and repeated under extreme test conditions. Both extremes of voltage shall be applied, at both extremes of temperature (clauses 5.2 and 5.3 applied simultaneously).

The frequency error limits are given in table 2.

7.1.3 Limits

Table 2: Frequency error limits

Channel separation (kHz)	Frequency error limits (kHz)			
	f < 47 MHz	f = 47 MHz to 137 MHz	f = 137 MHz to 300 MHz	f = 300 MHz to 470 MHz
10/12,5	±0,60	±1,00	±1,00 (B) ±1,50 (P)	±1,00 (B) ±2,50 (P)
20/25	±0,60	±1,35	±2,00	±2,00 ±2,50 (P)
NOTE: B = Base station. P = Pocket station.				

7.2 Carrier power

7.2.1 Definition

The transmitter carrier power is the mean power during one unmodulated RF cycle delivered to an artificial load or, in case of a transmitter with an integral antenna, the effective radiated power in the direction of maximum field strength under specified conditions of measurement.

7.2.2 Carrier power (conducted)

7.2.2.1 Method of measurement

The following method of measurement shall be used:

- the transmitter shall be connected to an artificial load and RF power meter;
- the power delivered to this artificial load shall be measured. The value measured shall be compared with the rated output power;
- the measurement shall be made under normal test conditions and extreme test conditions (extreme temperature) and supply voltage applied simultaneously (see clauses 5.2 and 5.3).

7.2.2.2 Limits

Under normal test conditions, the measured carrier output power shall be within ±1,5 dB of the rated carrier output power. Under extreme test conditions the measured carrier output power shall be within +2,0 dB and -3,0 dB of the rated carrier output power.

Base transmitters: the rated carrier output power shall nominally be less than or equal to 5 W (on-site), or 25 W (wide area). Pocket transmitters: the rated carrier output power shall be less than or equal to 0,05 W.

The maximum permitted transmitter output power may be further limited, according to local or national licensing regulations at time of installation.

7.2.3 Effective radiated power (on-site equipment with combined antenna)

7.2.3.1 Method of measurement

a) Method of measurement under normal test conditions:

- Using the measuring arrangement in figure 1, on a test site fulfilling the requirements of clause 6.4, the transmitter shall be placed at the specified height on the non-conductive support.
- The position shall be as follows:
 - for transmitters with an internal antenna, it shall stand in the position in which it is normally used;
 - for transmitters with a rigid external antenna, the antenna shall be vertical;
 - for transmitters with a non-rigid external antenna, with the antenna extended vertically upwards by a non-conducting support.

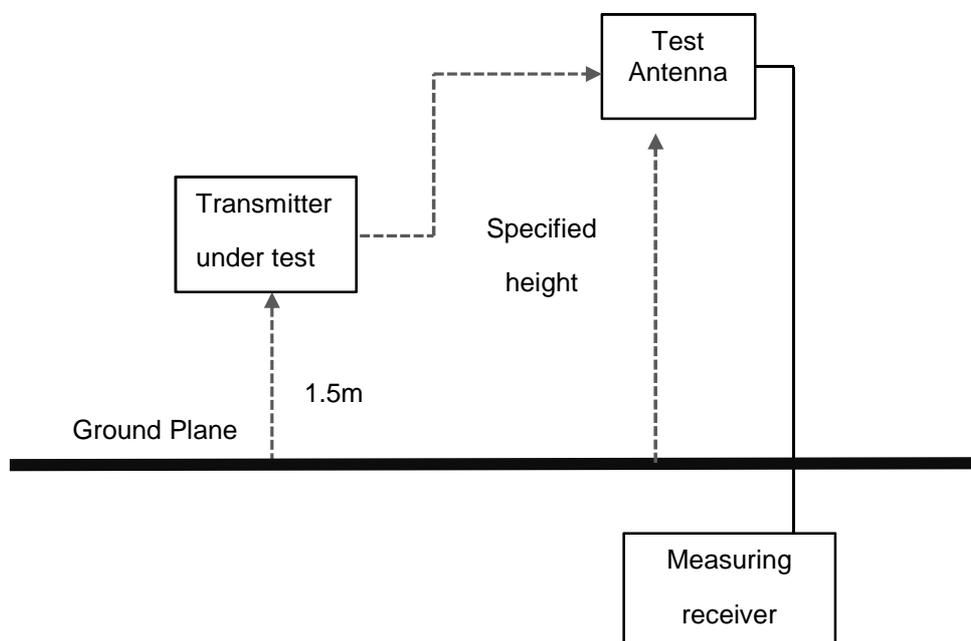


Figure 1: Measurement arrangement

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

The test antenna shall be orientated for vertical polarization. The signal level shall be measured as follows:

- 1) the transmitter shall be rotated through 360° until the maximum signal is detected on the measuring receiver;
- 2) then the test antenna shall be raised or lowered over a range of 1 m to 4 m, until the maximum signal is received.

NOTE: This maximum may be lower than the value obtainable at heights outside the specified limits.

Steps 1) and 2) above shall be repeated to ensure that the direction of maximum field strength is found.

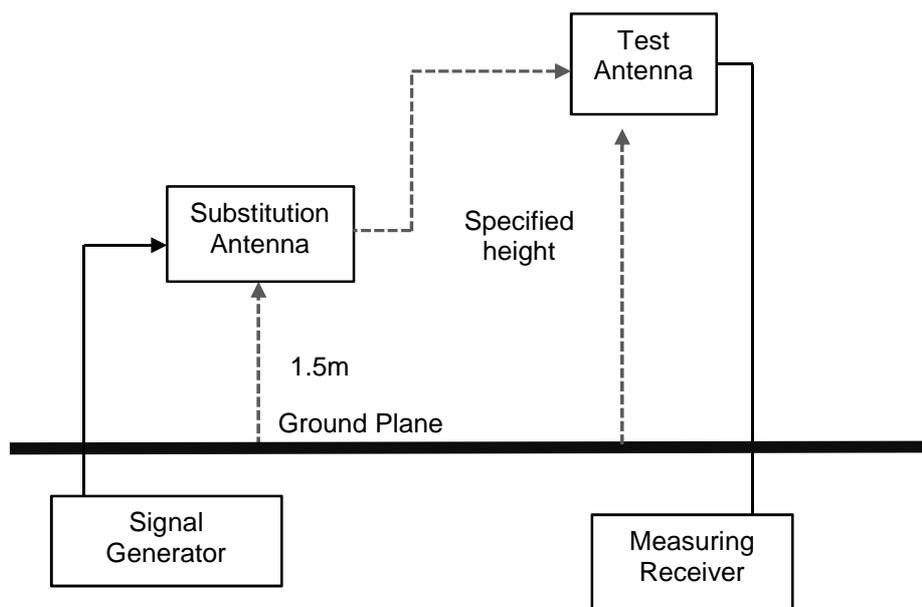


Figure 2: Substitution measurement arrangement

Using the measuring arrangement in figure 2, the transmitter shall be replaced by the substitution antenna as defined in clause B.1.6 and the test antenna shall be raised or lowered as necessary to ensure that the maximum signal is still received. The input signal to the substitution antenna shall be adjusted in level until an equal, or known related, level to that detected from the transmitter is obtained on the measuring receiver.

The carrier power is equal to the power supplied to the substitution antenna, if necessary adjusted by the known relationship.

The measurement shall be repeated for any alternative antenna supplied by the manufacturer.

A check shall be made at horizontal polarization to ensure that the value obtained above is the maximum. If a larger value is obtained, it shall be recorded in the test report.

a) Method of measurement under extreme test conditions:

- The transmitter shall be placed in the test fixture (see clause 6.3) and the power delivered to the artificial load shall be measured. 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.
- The power delivered to the artificial load is measured under normal and extreme test conditions (clauses 5.2 and 5.3 applied simultaneously) and the difference in dB noted. This difference is algebraically added to the carrier radiated power under normal test conditions, in order to obtain the carrier radiated power under extreme test conditions.

7.2.3.2 Limits

Base transmitters: the rated effective radiated carrier power shall be less than or equal to 5 W. Pocket transmitters: the rated effective radiated carrier power shall be less than or equal to 0,05 W.

The measured effective radiated carrier power under normal test conditions shall nominally be within $\pm 1,5$ dB from the rated effective radiated carrier power and shall not exceed ± 6 dB from the rated power when measurement uncertainty principles are applied.

The variation of the power due to the change of temperature and voltage for the measurement under extreme conditions, shall not exceed +2 dB or -3 dB (the measurements shall be performed using the test fixture).

7.3 Adjacent channel power

7.3.1 Definition

The adjacent channel power is that part of the total output power of a transmitter, modulated under a defined condition of modulation, which falls within a specified pass band centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter. It is specified either as the ratio expressed in decibels of the carrier power to the adjacent channel power, or as an absolute value.

7.3.2 Method of measurement

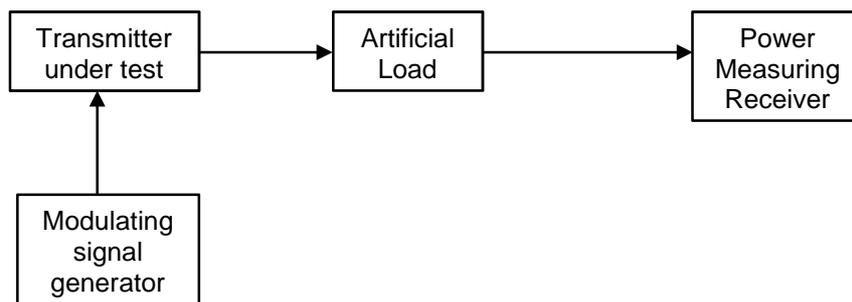


Figure 3: Measuring arrangement

Using the measuring arrangement given in figure 3, the adjacent channel power shall be measured with a power measuring receiver which conforms with annex C.

- a) The transmitter under test shall be connected via the artificial load to a measuring receiver calibrated to measure root-mean-squared (rms) power levels. The level at the input of the measuring receiver shall be within its specified limit(s). The transmitter shall be operated at the maximum operational carrier power level.

In the case of a transmitter without a 50 Ω antenna connection, the transmitter shall be placed in the test fixture, and the test fixture shall be connected to the measuring receiver.

NOTE: When using the test fixture for this measurement, it is important to ensure that direct radiation from the transmitter to the power measuring receiver does not affect the result.

- 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 meter reading 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 3.

Table 3: Frequency displacement

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

The same result may be obtained by tuning the power measuring receiver (point D0 on the power measuring filter shape, given in figure C.1, annex C), to the nominal frequency of the adjacent channel, if it has been suitably calibrated:

- d) The transmitter shall be modulated in accordance with clause 6.1.2 with the normal coded test signal D-M3 at the input level declared by the manufacturer. Additionally, where the transmitter has a speech facility, the test shall be repeated with normal test signal A-M2 according to clause 6.1.1 increased by 20 dB. In the case of a transmitter with an integrated microphone the level shall be increased by 10 dB.

- 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 steps 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) Steps a) to g) shall be repeated with the transmitter set to its minimum operational power level.

7.3.3 Limits

The limits for the adjacent channel power under normal conditions are given in table 4.

Table 4: Adjacent channel power limits

Channel spacing (kHz)	Limit under normal conditions	Limit under extreme conditions
10	20 μ W	25 μ W
12,5	60 dB below carrier power, without the need to be below 0,2 μ W	55 dB below carrier power, without the need to be below 0,2 μ W
20/25	70 dB below carrier power, without the need to be below 0,2 μ W	65 dB below carrier power, without the need to be below 0,2 μ W

7.4 Frequency deviation

7.4.0 General

These measurements are only applicable for transmitters of analogue speech.

7.4.1 Definition

The frequency deviation is the difference between the instantaneous frequency of the modulated RF signal and the carrier frequency, in the absence of modulation. For type testing purposes, only the maximum frequency deviation will be measured.

The maximum permissible frequency deviation is the maximum deviation under any conditions of modulation.

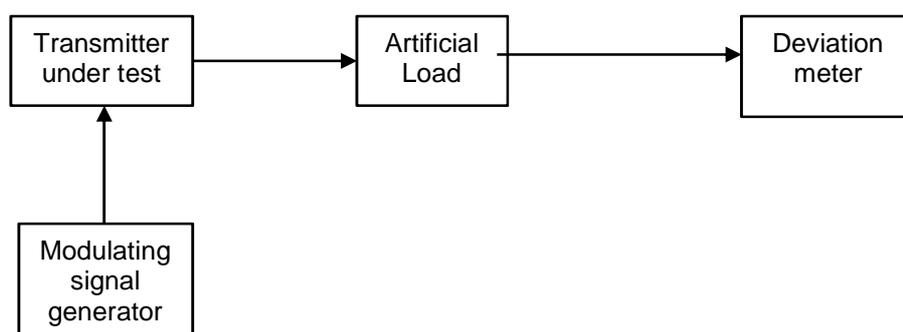


Figure 4: Measuring arrangement

7.4.2 Method of measurement

Using the measuring arrangement given in figure 4, the transmitter shall be connected to the artificial load. The frequency deviation shall be measured by means of a deviation meter capable of measuring the maximum permissible frequency deviation, including that due to any harmonics and intermodulation products which may be produced in the transmitter.

In case of transmitters without a 50 Ω connection, the transmitter shall be placed in the test fixture and the test fixture shall be connected to the artificial load.

7.4.3 Analogue signals within the audio bandwidth

7.4.3.1 Method of measurement

The following test method shall be used:

- a) the modulation frequency shall be varied between:
 - 300 and 3 000 Hz for equipment operating with 20 kHz or 25 kHz channel separation; and
 - between 300 Hz and 2 550 Hz for equipment operating with 10 kHz or 12,5 kHz channel separation.

The level of the test signal shall be 20 dB above the level of the normal signal A-M1 (see clause 6.1.1) or 10 dB in the case of a transmitter with an integrated microphone.

- b) the maximum (positive or negative) frequency deviation shall be recorded.

7.4.3.2 Limits

For transmitters with speech facility, the limits are given in table 5.

Table 5

Channel spacing (kHz)	Maximum Permissible Frequency Deviation (MPFD) (kHz)
10	2
12,5	2,5
20	4
25	5
NOTE: For all other transmitters there are no limits (however, the provisions within clause 7.3 still apply).	

7.4.4 Analogue signals above the audio bandwidth

7.4.4.1 Method of measurement

The following method of measurement shall be used:

- a) The modulation frequency shall be varied between:
 - 3,0 kHz and 20 kHz for 20 kHz channel separation;
 - 3,0 kHz and 25 kHz for 25 kHz channel separation;
 - 2,55 kHz and 10 kHz for 10 kHz channel separation; and
 - 2,55 kHz and 12,5 kHz for 12,5 kHz channel separation.

The level of the test signal shall be equal to the level of the normal test signal A-M1 (see clause 6.1.1).

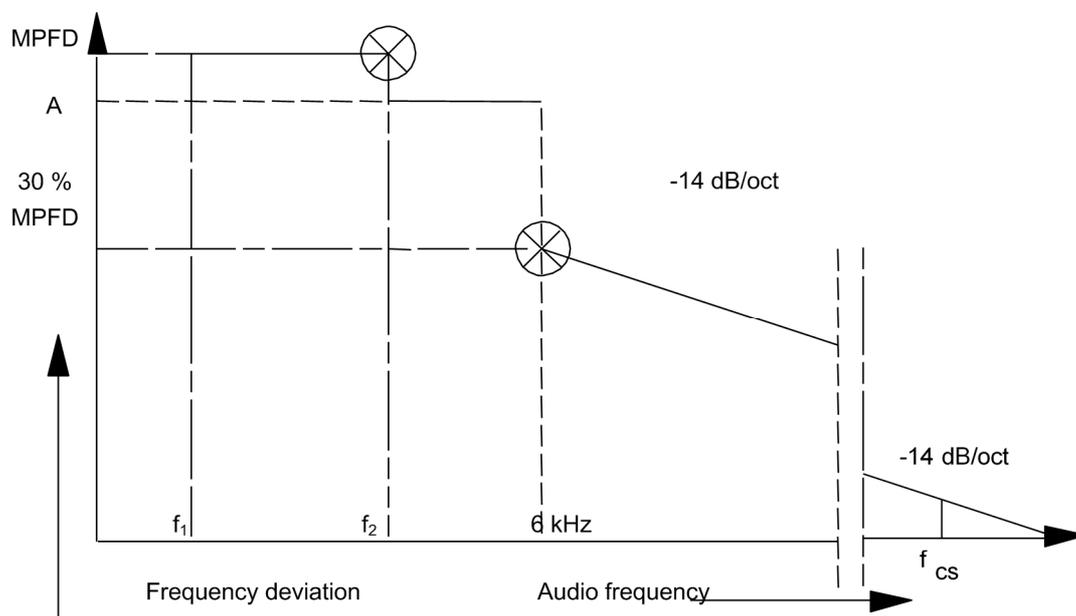
7.4.4.2 Limits

Between 3 kHz/2,55 kHz and 6 kHz the frequency deviation shall not exceed the frequency deviation at a modulation frequency of 3 kHz/2,55 kHz.

At 6 kHz, the deviation shall not be more than 30 % of the maximum permissible frequency deviation (see table 5 in clause 7.4.3.2).

The frequency deviation at modulation frequencies between 6 kHz and a frequency equal to the channel separation for which the equipment is intended shall not exceed the value given by linear representation of the frequency deviation (dB) relative to the modulation frequency, starting at the 6 kHz limit and having a slope of -14,0 dB per octave.

These limits are illustrated in figure 5.



- f1:** Lowest appropriate frequency.
f2: 3 kHz (for 20 kHz or 25 kHz channel separation); or 2,55 kHz (for 12,5 kHz or 10 kHz channel separation).
MPFD: Maximum permissible frequency deviation, clause 7.4.3.2.
A: Measured frequency deviation at f2.
fcs: Frequency equal to channel separation.

Figure 5

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

7.5 Spurious emissions

7.5.1 Definition

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation.

The level of spurious emissions shall be measured as either:

- their power level in a specified load (conducted spurious radiation) and their effective radiated power when radiated by the cabinet and structure of the equipment (cabinet radiation); or
- their effective radiated power when radiated by the cabinet and the integral antenna, in the case of pocket equipment fitted with such an antenna and having no external RF connector.

7.5.2 Method of measurement

7.5.2.0 General

The bandwidth used in this measurement for each spurious radiation, shall be sufficiently wide to accept all significant components of the spurious radiation concerned. The conditions used in the relevant measurements shall be reported in the test report. It is assumed that a (-6 dB) bandwidth of 120 kHz is sufficiently wide and a correct value for this measurement.

7.5.2.1 Method of measuring the spurious conducted power level

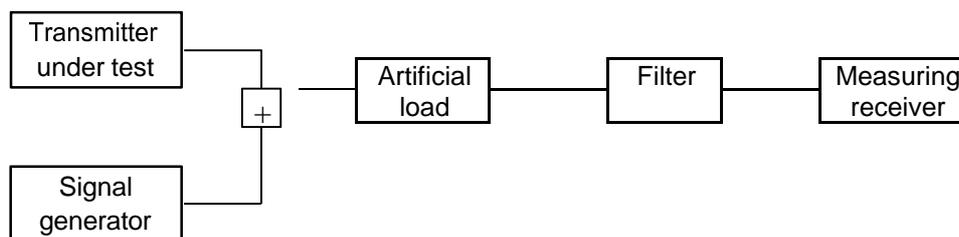


Figure 6: Measuring arrangement

This method applies only to equipment having an external connector and it is assumed that all equipment operates below 470 MHz.

Spurious emissions shall be measured as the power level of any discrete signal delivered into a 50 Ω load. This may be done by connecting the transmitter output through an attenuator to a measuring receiver, or by monitoring the relative levels of the spurious signals delivered to an artificial load.

The measurement shall be made at the highest and the lowest power level to which the transmitter can be set.

If possible, the transmitter shall be unmodulated and the measurements made in the frequency range 9 kHz to 4 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

If an unmodulated carrier cannot be obtained, the measurement shall be made with the transmitter modulated by the normal test signal D-M3 (see clause 6.1.2), in which case this fact shall be recorded in the test report.

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

7.5.2.2 Method of measuring the effective radiated spurious power level

On a test site, fulfilling the requirements of clause 6.4, the sample shall be placed at the specified height on the support. The transmitter shall be operated at the carrier power as specified in clause 7.2, delivered to:

- an artificial load for equipment having an external antenna connector;
- or to the integral antenna.

If possible, the transmitter shall be unmodulated and the radiation of any spurious components shall be detected by the test antenna and receiver, over the frequency range 25 MHz to 4 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

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

If an unmodulated carrier cannot be obtained, the measurement shall be made with the transmitter modulated by the normal test signal D-M3 (see clause 6.1.2), in which case this fact shall be recorded in the test report.

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

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

7.5.3 Limits

The limits for conducted emission are given in table 6.

Table 6: Conducted emissions

Frequency range	9 kHz to 1 GHz	Above 1 GHz to 4 GHz
Tx operating	0,25 μ W	1 μ W
Tx stand-by	2 nW	20 nW

The limits for radiated emissions are given in table 7.

Table 7: Radiated emissions

Frequency range	25 MHz to 1 GHz	Above 1 GHz to 4 GHz
Tx operating	0,25 μ W	1 μ W
Tx stand-by	2 nW	20 nW

NOTE: It is assumed that all equipment operates below 470 MHz.

7.6 Transmitter transient behaviour

7.6.1 Definition

7.6.1.0 General

The transient behaviour of transmitters is determined by the time-dependency of the transmitter frequency and the transmitter power when the transmitter output power is switched on and off. Within the scope of the present document, only the transient behaviour of the transmitter carrier frequency shall be measured.

The following frequency tolerances and transient times are specified:

- f_0 : frequency tolerance in the steady state;
- f_1 : frequency difference which shall be less than one channel separation;
- f_2 : frequency difference which shall not be greater than half the channel separation;
- t_1 : period of time during which frequency tolerance f_1 applies;
- t_2 : period of time during which frequency tolerance f_2 applies;
- t_3 : period of time during which the frequency error on the carrier applies;
- t_{on} : period of time during which frequency tolerance f_0 applies.

According to the method of measurement described in clause 7.6.2, the switch-on instant (T_{on}) of a transmitter is defined by the condition when the output power, measured at the antenna terminal, exceeds 10 % of the nominal power. However, this value shall not be greater than 100 mW. The switch-off instant (T_{off}) is given when the nominal power falls below this limit.

The different frequency tolerance schemes have to be applied for the following cases.

7.6.1.1 Keying criteria when the transmitter output power is switched on

The transient times and frequency tolerances are shown in figure 7.

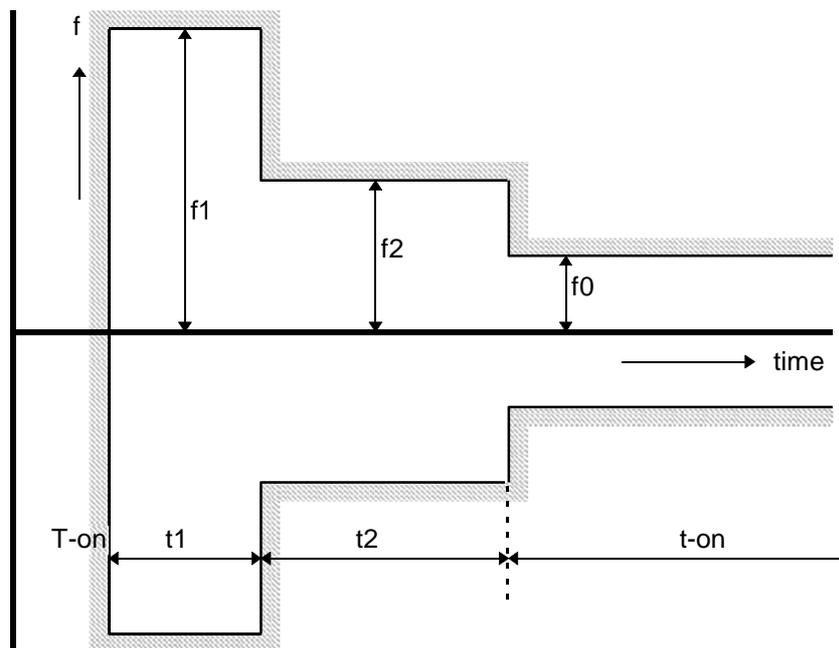


Figure 7

7.6.1.2 Keying criteria when the transmitter output power is switched off

The transient time is not subdivided; the frequency tolerance is shown in figure 8.

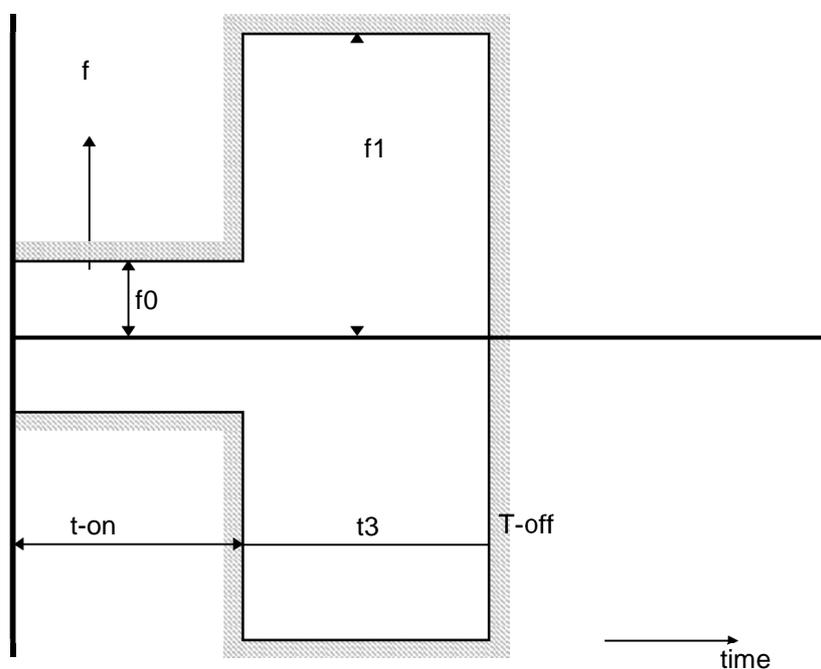


Figure 8

7.6.2 Method of measurement

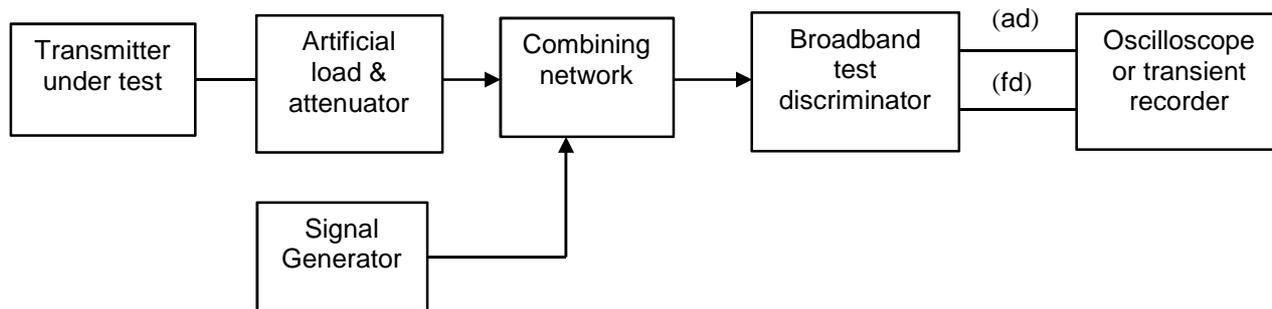


Figure 9: Measuring arrangement

Using the configuration illustrated in figure 9, the signals of the transmitter under test and the signal generator shall be connected to the test discriminator via a combining network. The transmitter shall be connected to a 50 Ω power attenuator. The output of the power attenuator shall be connected to the test discriminator via one input of the combining network. A test signal generator shall be connected to the second input of the combining network.

The test signal shall be adjusted to the nominal frequency of the transmitter. The test signal shall be modulated by a frequency of 1 kHz, with a deviation equal to plus or minus 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, as 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 one 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 mark the beginning of t_{on} . The periods of time t_1 and t_2 , as defined in clause 7.6.1, 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 7.6.3. The frequency difference, after the end of t_2 shall be within the limits of the frequency error, clause 7.1.3. The results 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 one 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 mark the beginning of t_{off} . The period of time t_3 as defined in clause 7.6.1, 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 7.6.3. Before the start of t_3 the frequency difference shall be within the limit of the frequency error, given in table 2 in clause 7.1.3. The result shall be recorded as frequency difference versus time.

7.6.3 Limits

Table 8: Base station transmitters

Transient time	Carrier frequency ≤ 300 MHz	Carrier frequency > 300 MHz	Maximum frequency deviation
t1	5 ms	10 ms	1,0 channel separation
t2	20 ms	25 ms	0,5 channel separation
t3	5 ms	10 ms	1,0 channel separation

7.7 Maximum transmission time

7.7.1 Definition

Intended as a channel occupancy safeguard under fault conditions, the maximum transmission time is the total transmission time following an activation by either PTT, VOX control or any other mechanism.

7.7.2 Method of measurement

The measurement arrangement in figure 3 shall be used. The measurement procedure shall be as follows:

- the transmitter under test shall be activated;
- the output power shall be monitored;
- the time between the start of transmission and the end of the transmission, shall be noted.

NOTE 1: The start of transmission is taken as the time when the measured power has increased from a value at least 70 dB below the value measured in clause 7.2 to not less than 3 dB below the value measured in clause 7.2.

NOTE 2: The end of transmission is taken as the time when the measured power has reduced by at least 70 dB below the value measured in clause 7.2.

7.7.3 Limits

The maximum transmission time shall be less than 180 seconds.

8 Receiver Requirements

8.1 Paging receivers reference sensitivity (field strength, data)

8.1.1 Definition

Receivers with an integral antenna:

- the reference sensitivity of a receiver is the field strength level expressed in dB μ V/m, which is 3 dB above the minimum level of a carrier at the nominal frequency of the receiver and modulated with the normal data test signal (see clause 6.1) which will without interference, produce an 80 % (4 out of 5) successful call rate. The average reference sensitivity is calculated from eight measurements of field strength, when the receiver is rotated in 45° increments, starting at a particular orientation.

Receivers with a 50 Ω connector: the measured sensitivity of the receiver is the minimum level of signal at the nominal frequency of the receiver, which produces a message acceptance ratio of 80 %.

8.1.2 Method of measurement

Receivers with an integral antenna:

- on a test site fulfilling the requirements of annex B and the measuring arrangement in figure 10, the sample receiver shall be placed on a non-conducting support, at a height of 1,5 m above the ground plane. The attitude of the receiver shall be adjusted to be that which is closest to normal use.

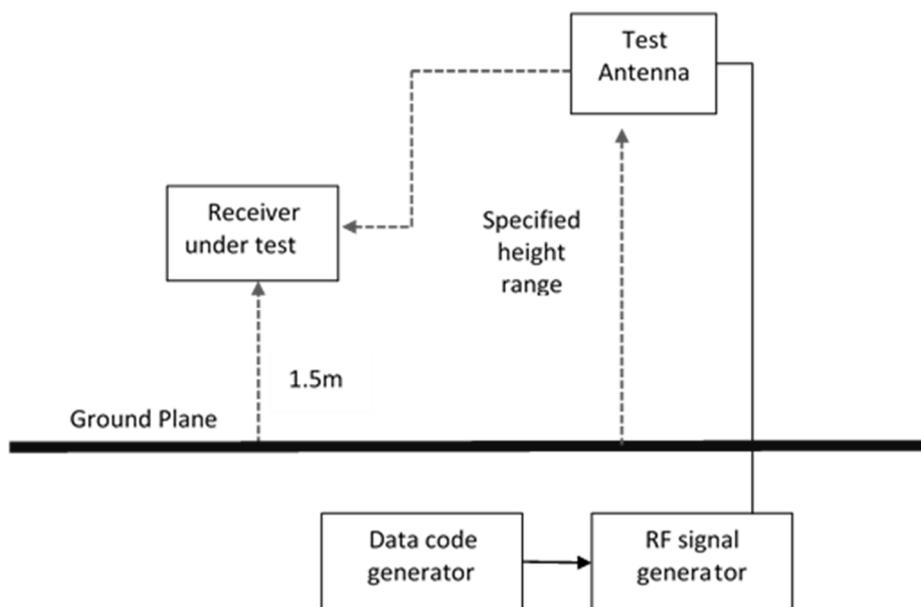


Figure 10: Measuring arrangement

The test transmitting aerial shall be set for vertical polarization and supplied with an RF signal which is modulated with the normal data test signal D-M3 as specified in clause 6.1.2. The RF level shall be adjusted until a successful call rate of 80 % is achieved. This operation shall then be repeated as the receiver is rotated through 360°, until the lowest RF level value of the transmitted signal which produces an 80 % successful call rate is obtained.

With the RF signal generator output maintained at this level, the test receiver shall be replaced by an antenna connected to an RF field-strength measurement receiver and the ambient level in dB relative to 1 microvolt per metre measured.

Receivers with a 50 Ω connector - the output of the RF signal generator shall be connected directly to the 50 Ω antenna socket and the RF level adjusted until a successful call rate of 80 % is achieved.

8.1.3 Limits

Receivers with an integral antenna: the receiver reference sensitivity level is taken to be 3 dB above the value as determined above and shall not exceed 30 dB μ V/m for on-site pagers and 20 dB μ V/m for pagers on wide-area systems.

Receivers with a 50 Ω connector: the measured sensitivity value shall not exceed +3 dB μ V emf under normal test conditions and +9 dB μ V emf under extreme test conditions.

8.2 Adjacent Channel Selectivity

8.2.1 Definition

The adjacent channel selectivity of a receiver, is a measure of its capability to successfully continue to operate at a specified calling rate from a signal transmitted at the reference sensitivity level, in the presence of a modulated signal in the adjacent channel. It is specified as the lower value of the ratios in dB for the upper and lower adjacent channels, of the level of the unwanted signal to a specified level of the wanted signal, for which the message acceptance rate is 80 %.

8.2.2 Method of measurement

Receivers with an integral antenna:

- the receiver shall be placed in the test fixture (see clause 6.3) and configured in the measuring arrangement as shown in figure 11.

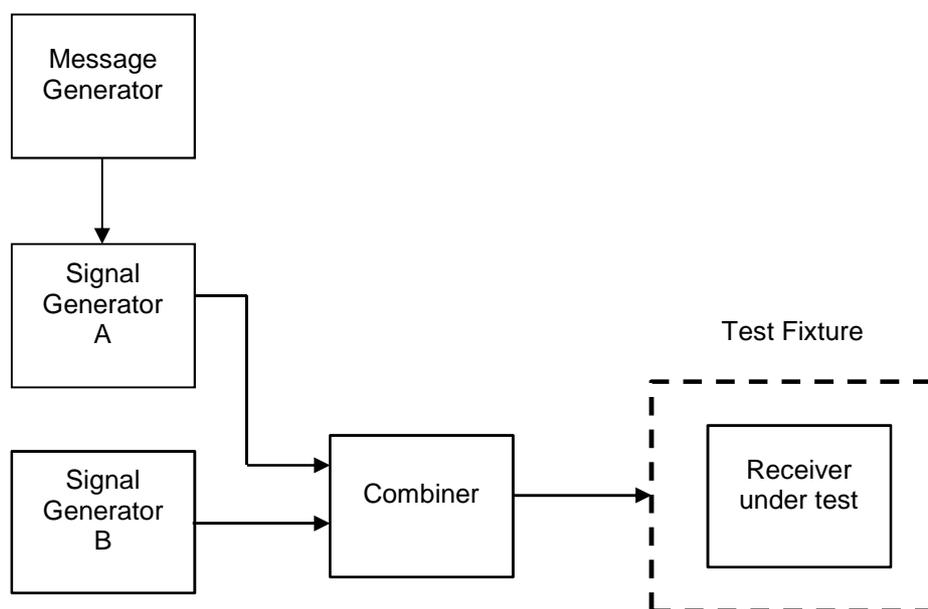


Figure 11: Measuring arrangement

The wanted RF signal from generator A shall be at the nominal frequency of the receiver and modulated with a normal coded test signal D-M3. The unwanted signal A-M3 from generator B, shall be modulated in accordance with clause 6.1.2 and shall be set at the frequency of the channel immediately above that of the wanted signal.

Initially the unwanted signal shall be switched off and the level of the wanted signal adjusted to achieve a call success rate of 80 %. This level shall then be raised by 3 dB and the level recorded in dB relative to 1µV. The unwanted signal shall then be switched on and its level increased until the call success rate is reduced back to 80 %. The output level of generator B shall be recorded. The measurement shall be repeated, with the unwanted signal at the frequency of the channel immediately below that of the wanted signal.

Receivers with a 50 Ω connector:

- the receiver shall be configured as shown in figure 11, except that the output from the combining unit shall be directly connected to the 50 Ω input socket of the receiver.

The adjacent channel selectivity shall be expressed as the lower values in dBs, of the ratios of the unwanted signals to the level of the wanted signal.

The measurements shall be made at both normal and extreme test conditions (see clauses 5.2 and 5.3).

8.2.3 Limits

For a channel separation of 25 kHz, the adjacent channel selectivity under normal test conditions shall be not less than 55 dB for on-site pagers and 60 dB for wide area. Under extreme test conditions, the limits shall be not less than 45 dB for on-site pagers and 55 dB for wide area pagers.

For a channel separation of 12,5 kHz, the adjacent channel selectivity under normal test conditions shall be not less than 50 dB for on-site pagers and 55 dB for wide area. Under extreme test conditions, the limits shall be not less than 40 dB for on-site pagers and 50 dB for wide area pagers.

8.3 Co-channel rejection

8.3.1 Definition

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

8.3.2 Method of measurement

Receivers with an integral antenna: - the receiver shall be placed in the test fixture (see clause 6.3) and configured in the measuring arrangement as shown in figure 11. The wanted RF signal from generator A shall be at the nominal frequency of the receiver and modulated with a normal coded test signal D-M3. The unwanted signal A-M3 from generator B, shall be modulated in accordance with clause 6.1.2 and shall also be set at the nominal frequency of the receiver.

Initially the unwanted signal shall be switched off and the level of the wanted signal adjusted to achieve a call success rate of 80 %. This level shall then be raised by 3 dB and the level recorded in dB relative to 1 μ V. The unwanted signal shall then be switched on and its level increased until the call success rate is reduced back to 80 %. The output level of generator B shall be recorded.

Receivers with a 50 Ω connector: - the receiver shall be configured as shown in figure 11, except that the output from the combining unit shall be directly connected to the 50 Ω input socket of the receiver.

8.3.3 Limits

The co-channel rejection shall be expressed as the ratio in dB, of the level of the unwanted signal to the level of the wanted signal.

The specified range shall be between:

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

8.4 Intermodulation response rejection

8.4.1 Definition

Intermodulation response rejection is a measure of the capability of a paging receiver to inhibit the generation of a successful decoder response, which is caused by unwanted signals of equal level and having specific frequency relationships to the nominal operating frequency, one of which is modulated by the normal coded test signal.

8.4.2 Method of measurement

Receivers with an integral antenna:

- The receiver shall be placed in the test fixture (see clause 6.3) and configured in the measuring arrangement as shown in figure 11.
- The wanted RF signal from generator A shall be at the nominal frequency of the receiver and modulated with a normal coded test signal D-M3.
- The unwanted signal from generator B, shall be un-modulated and set at a channel frequency, 4 channels above the receivers operating frequency.

Initially the unwanted signal shall be switched off and the level of the wanted signal adjusted to achieve a call success rate of 80 %. This level shall then be raised by 3 dB and the level recorded in dB relative to $1\mu\text{V}$; this is the reference signal level. The frequency of this wanted signal shall then be adjusted to be eight channels above the nominal operating frequency of the receiver. This is now the second unwanted signal.

The levels of the two RF signals shall be kept equal and increased until a valid decoded response is achieved in the receiver. If necessary, the levels and frequencies of the two signals may be re-adjusted, to establish the minimum level at which valid response is obtained.

Receivers with a $50\ \Omega$ connector:

- the receiver shall be configured as shown in figure 11, except that the output from the combining unit shall be directly connected to the $50\ \Omega$ input socket of the receiver.

The levels of the signals under these conditions shall be recorded. The ratio, in dBs, of the levels of the two unwanted signals to the original reference signal level, is the intermodulation response rejection.

8.4.3 Limits

The intermodulation response rejection, shall not be less than 50 dB.

8.5 Spurious response rejection

8.5.1 Definition

Spurious response rejection is a measure of the capability of a paging receiver to operate to a specified successful calling rate from a wanted signal at the reference sensitivity, in the presence of signal at any other frequency.

8.5.2 Method of measurement

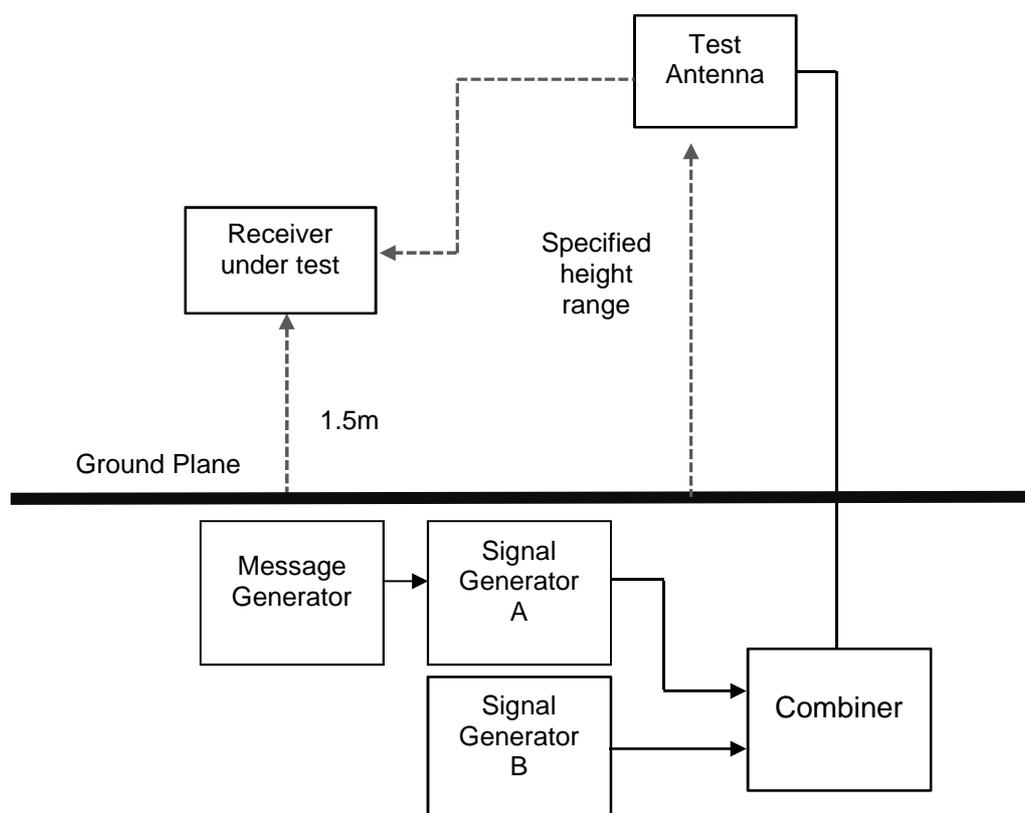


Figure 12: Measuring arrangement

Receivers with an integral antenna: on a test site fulfilling the requirements of annex B and the measuring arrangement in figure 12, the sample receiver shall be placed on a non-conducting support, at a height of 1,5 m above the ground plane. The attitude of the receiver shall be adjusted, to be that at which the reference sensitivity was obtained.

The test transmitting aerial shall be set for vertical polarization and supplied with an RF signal from generator A, which is modulated with the normal data test signal D-M3 as specified in clause 6.1.2. The RF level shall be adjusted until a successful call rate of 80 % is achieved. This operation shall then be repeated until the lowest RF level value of the transmitted signal which produces an 80 % successful call rate is obtained. Increase the recorded level by 3 dB; this shall be the wanted reference sensitivity level.

A second test signal shall be applied to the test transmitting antenna from generator B, via the second path of the combining unit. This test signal shall be unmodulated, and shall be adjusted to a frequency at which it is anticipated that spurious response could occur. This signal constitutes the unwanted signal.

The level of the unwanted signal shall be increased, until the successful calling rate is reduced to 80 %.

The unwanted signal shall be maintained at this level and the receiver replaced by the substitution antenna connected to the calibrated measuring receiver, and the field strength relative to 1 microvolt per metre determined. The spurious response rejection is expressed as the difference between the field strength recorded and the reference sensitivity.

Receivers with a 50 Ω connector - see clause 9.8.2 for test method.

The measurements shall be repeated for each frequency at which it is anticipated a spurious response could occur.

8.5.3 Limits

At any frequency in the range 30 MHz to 1 000 MHz, the spurious response rejection shall be not less than 50 dB.

8.6 Spurious emissions

8.6.1 Definition

Spurious emissions from receivers are any emissions radiated from the unit. They are specified as the radiated power of any discrete signal.

8.6.2 Method of measurement

On a test site fulfilling the requirements of clause 6.4, the sample receiver shall be placed at the specified height on a non-conductive support and the receiver shall be switched on.

Radiation of any spurious component shall be detected by the test antenna and measuring receiver, over the frequency range 25 MHz to 4 GHz.

At each frequency at which a component is detected:

- 1) the receiver under test shall be rotated through 360° until the maximum signal is detected on the measuring receiver;
- 2) the test antenna shall be raised or lowered through the specified height range until the maximum signal is received.

NOTE: This maximum may be lower than the value obtainable at heights outside the specified limits.

Steps 1) and 2) shall be repeated to ensure that the direction of maximum field-strength is found. After that, a substitution method shall be carried out to precisely define the power of the spectral component.

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

8.6.3 Limits

The power of any spurious component in the specified range of frequencies shall not exceed:

- 2 nW below 1 GHz; and
- 20 nW above 1 GHz.

9 Base station receivers

9.1 Measured sensitivity for analogue speech

9.1.1 Definition

The measured sensitivity for analogue speech of the receiver is the minimum level of signal at the nominal frequency of the receiver which produces, through a psophometric weighting network, a (Signal + Noise And Distortion)/(Noise + Distortion) ratio (SINAD) ratio of 20 dB.

9.1.2 Method of measurement

A signal generator shall be connected to the receiver input. The signal generator shall be at the nominal frequency and modulated with the test modulation A-M1 (see clause 6.1.1) and the amplitude shall be adjusted until a weighted SINAD ratio of 20 dB is obtained.

The test signal input level under these conditions is the value of the measured sensitivity for analogue speech. This input level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The measurement shall be repeated under extreme test conditions.

9.1.3 Limits

The measured sensitivity values shall not exceed +6 dB μ V emf under normal conditions, and +12 dB μ V emf under extreme test conditions.

9.2 Measured sensitivity for messages

9.2.1 Definition

The measured sensitivity for messages of the receiver is the minimum level of signal at the nominal frequency of the receiver which produces, after demodulation, a message acceptance ratio of 80 %.

9.2.2 Method of measurement

A signal generator shall be connected to the receiver input. The signal generator shall be at the nominal frequency and modulated with the test signal D-M3 (see clause 6.1.2). The amplitude of the signal generator output shall be adjusted until a successful message response rate of 10 % is obtained.

The test signal shall be applied repeatedly whilst observing in each case whether or not a successful response is obtained. The input level shall be increased 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 be measured. This input level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The input signal level shall be reduced by 1 dB and the new value recorded. The test signal shall then be continuously repeated. In each case, if a response is not obtained, the input level shall be increased by 1 dB and the new value recorded. If a successful response is obtained, the input level shall not be changed until three consecutive successful responses have been observed. In this case the input level shall be reduced by 1 dB and the new value recorded. No input signal levels shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values has been recorded.

The measured sensitivity for messages is the average of the values recorded in steps c) and d). This value shall be recorded.

The measurement shall be repeated under extreme test conditions.

9.2.3 Limits

The measured sensitivity value shall not exceed +3 dB μ V emf under normal test conditions and +9 dB μ V emf under extreme test conditions.

9.3 Co-channel rejection for analogue speech

9.3.1 Definition

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

It is specified as the ratio in dB of the level of the unwanted signal to the specified wanted signal level at the receiver input, which produces through a psophometric weighting network a SINAD ratio of 14 dB.

9.3.2 Method of measurement

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with the test signal A-M1. The signal level of generator A shall be 6 dB μ V emf under normal test conditions. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The unwanted signal, represented by generator B, shall also be at the nominal frequency and modulated with the test signal A-M3 (see clause 6.1.1) and adjusted until the SINAD ratio of 14 dB is obtained.

The co-channel ratio for analogue speech shall be recorded as the ratio in dB of the level of the unwanted signal, to the level of the wanted signal at the receiver input.

9.3.3 Limits

The co-channel rejection ratio shall be between:

- -8 dB and 0 dB for a channel separation of 20 kHz and 25 kHz;
- -12 dB and 0 dB for a channel separation of 10 kHz and 12,5 kHz.

9.4 Co-channel rejection for messages

9.4.1 Definition

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

It is specified as the ratio in dB of the level of the unwanted signal, to the specified wanted signal level at the receiver input, for which the message acceptance ratio is 80 %.

9.4.2 Method of measurement

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with test signal D-M3 (see clause 6.1.2). The signal level of generator A shall be 6 dB μ V emf under normal test conditions. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted signal, represented by generator B, shall also be at the nominal frequency and modulated with the test signal A-M3 (see clause 6.1.1) and adjusted until a successful message ratio of less than 10 % is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be measured. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal, as previously determined above, shall then be continuously repeated. 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 recorded. If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded, unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

The co-channel rejection ratio for messages shall be recorded as the ratio in dB of the average of the levels of the unwanted signals, to the level of the wanted signal, at the receiver input.

9.4.3 Limits

The co-channel rejection ratio shall be between:

- -8 dB and 0 dB for a channel separation of 20 kHz and 25 kHz;
- -12 dB and 0 dB for a channel separation of 10 kHz and 12,5 kHz.

9.5 Adjacent channel selectivity for analogue speech

9.5.1 Definition

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

It is specified as the lower value of the ratios in dB, for the upper and lower adjacent channels, of the level of the unwanted signal to a specified level of the wanted signal which produces through a psophometric weighting network a SINAD ratio of 14 dB.

9.5.2 Method of measurement

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with the test signal A-M1 (see clause 6.1.1). The signal level of generator A shall be 6 dB μ V emf under normal test conditions and +12 dB μ V emf under extreme test conditions. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The unwanted modulated signal, represented by generator B and modulated with the test signal A-M3, (see clause 6.1.1) shall be at the channel frequency immediately above that of the wanted signal.

The level of generator B shall be adjusted until the SINAD ratio of 14 dB is obtained. The ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input shall be recorded.

The measurement shall be repeated with an unwanted signal at the frequency of the channel below that of the wanted signal and the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input shall be recorded.

The measurement shall be repeated under extreme test conditions, using the relevant value of the wanted signal.

9.5.3 Limits

The lower value of the ratio in dB of the upper and lower adjacent channels shall, for different channel separations, not be less than the value given in table 9.

Table 9

Conditions	Channel spacing	
	10/12,5 kHz	20/25 kHz
normal	60 dB	70 dB
extreme	50 dB	60 dB

9.6 Adjacent channel selectivity for messages

9.6.1 Definition

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

It is specified as the lower value of the ratios in dB for the upper and lower adjacent channels of the level of the unwanted signal to a specified level of the wanted signal, for which the message acceptance rate is 80 %.

9.6.2 Method of measurement

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with the test signal D-M3 (see clause 6.1.2). The signal level of generator A shall be 6 dB μ V emf under normal test conditions and +12 dB μ V emf under extreme test conditions. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted signal, modulated by the test signal A-M3 (see clause 6.1.1) and represented by generator B, shall be at the channel frequency immediately above that of the wanted signal. The level of generator B shall be adjusted until a successful message ratio of less than 10 % is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be measured. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case where a response is not obtained, the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. 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 recorded. No levels of the unwanted signal shall be recorded, unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

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

The adjacent channel selectivity for messages shall be recorded for the upper and lower adjacent channels as the average of the levels of the unwanted signal, to the level of the wanted input signal.

9.6.3 Limits

The lower value of the ratio in dB of the upper and lower adjacent channels shall, for different channel separations, not be less than the value given in table 10.

Table 10

Conditions	Channel spacing	
	10/12,5 kHz	20/25 kHz
normal	60 dB	70 dB
extreme	50 dB	60 dB

9.7 Spurious response immunity for analogue speech

9.7.1 Definition

The spurious response immunity for analogue speech, is a measure of the capability of the receiver to receive a wanted modulated signal at the nominal frequency, without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, that differs from the wanted signal by more than one channel separation and at which a response is obtained.

It is specified as the value of the ratio in dB of the level of the unwanted signal to a specified level of the wanted signal which produces, through a psophometric weighting network, a SINAD ratio of 14 dB.

9.7.2 Method of measurement

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with the normal test signal A-M1 (see clause 6.1.1). The signal level of generator A shall be 6 dB μ V emf. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The level of the unwanted signal, modulated by the test signal A-M3 (see clause 6.1.1) and represented by generator B, shall be adjusted to 80 dB above the level of the wanted signal, when measured at the receiver input. The frequency of the unwanted signal shall then be varied over the frequency range 100 kHz to 2 GHz, plus any other frequencies within the full specified frequency range at which it is calculated that a spurious response could occur. The frequencies of all responses shall be noted.

At any frequency where a response is obtained, the unwanted modulated signal level shall be adjusted until a SINAD ratio of 14 dB is obtained. The spurious response immunity shall be recorded for the frequency concerned, as the ratio in dB between the unwanted modulated signal and the wanted signal at the receiver input.

9.7.3 Limit

The spurious response immunity for analogue speech shall not be less than 70 dB.

9.8 Spurious response immunity for messages

9.8.1 Definition

The spurious response immunity for messages is a measure of the capability of the receiver to receive a wanted signal at the nominal frequency, without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, that differs from the wanted signal by more than one channel separation, and at which a response is obtained.

It is specified as the value of the ratios in dB of the level of the unwanted signal, to a specified level of the wanted signal for which the message acceptance rate is 80 %.

9.8.2 Method of measurement

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with the test signal D-M3 (see clause 6.1.2). The signal level of generator A shall be adjusted to 6 dB μ V emf. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The frequency of the unwanted signal, modulated by the test signal A-M3 (see clause 6.1.1) and represented by generator B, shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur. The level of the unwanted modulated signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be measured. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. 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 recorded. No levels of the unwanted signal shall be recorded, unless preceded by a change in level. The measurement shall be stopped after a total of 10 values has been recorded.

The measurement shall be repeated at each frequency within the specified frequency range at which it is calculated that a spurious response could occur.

The spurious response immunity for messages shall be recorded for the frequency concerned, as the ratio in dB of the average of the levels at the receiver input, of the recorded unwanted signal from generator B, to the level of the wanted signal from generator A.

9.8.3 Limit

The spurious response immunity for messages shall not be less than 70 dB.

9.9 Intermodulation immunity for analogue speech

9.9.1 Definition

The intermodulation immunity for analogue speech is a measure of the capability of the receiver to receive a wanted signal at the nominal frequency, without exceeding a given degradation due to the presence of two or more unwanted signals with a special frequency relationship to the wanted signal frequency.

It is specified as the ratio in dB of the common level of two unwanted signals, to a specified level of the wanted signal at the receiver input, which produces through a psophometric weighting network a SINAD ratio of 14 dB.

9.9.2 Method of measurement

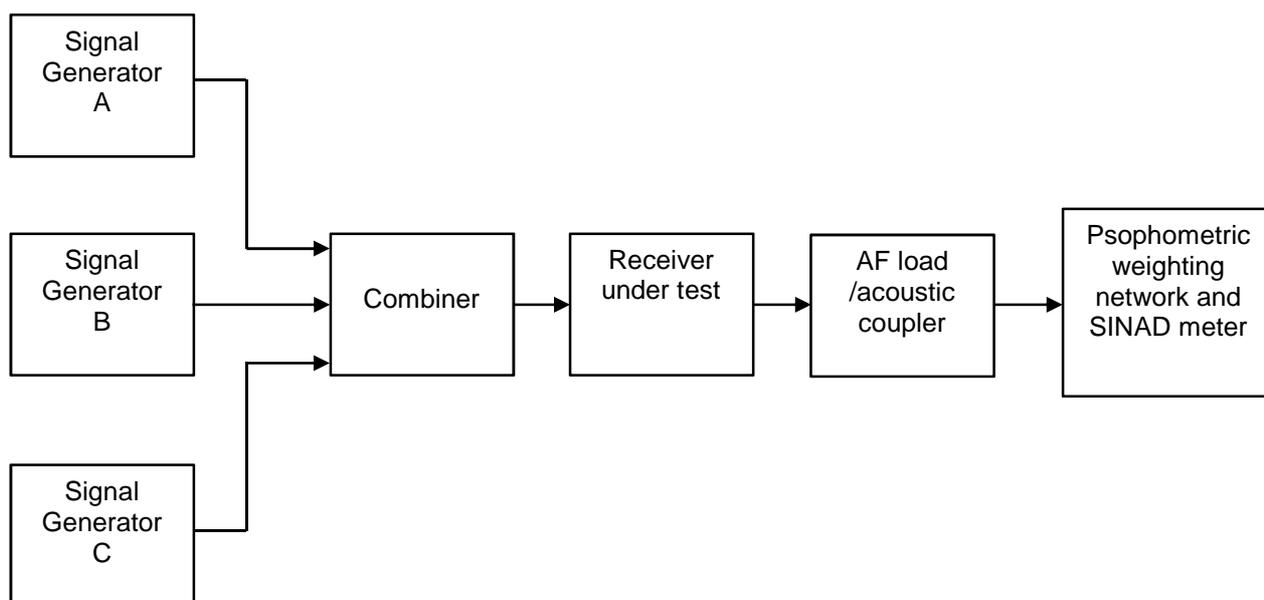


Figure 13: Measuring arrangement

Three signal generators, A, B and C, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated with the normal test signal A-M1 (see clause 6.1.1). The signal level of generator A shall be 6 dB μ V emf. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted signal, represented by generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the nominal frequency. The second unwanted signal, modulated by the test signal A-M3 (see clause 6.1.1) and represented by signal generator C, shall be adjusted to a frequency 100 kHz above the nominal frequency.

The amplitude level of the two unwanted signals shall be maintained equal and shall be adjusted until a SINAD ratio of 14 dB is obtained. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected. The frequency of signal generator B shall be adjusted to produce the maximum degradation of the SINAD ratio. The level of the two unwanted signals shall be readjusted to restore the SINAD ratio of 14 dB. This level shall be recorded.

The intermodulation immunity for analogue speech shall be recorded as the ratio in dB, of the level of the unwanted signals to the level of the wanted signal.

The measurements shall be repeated, with the unwanted signal (generator B) at a frequency 50 kHz below the nominal frequency of the receiver and the frequency of the unwanted modulated signal (generator C) at the frequency 100 kHz below the nominal frequency.

9.9.3 Limit

The intermodulation immunity shall not be less than 60 dB.

9.10 Intermodulation immunity for messages

9.10.1 Definition

The intermodulation immunity for messages, is a measure of the capability of the receiver to receive a wanted signal at the nominal frequency, without exceeding a given degradation due to the presence of two or more unwanted signals with a special frequency relationship to the wanted signal frequency.

It is specified as the ratio in dB of the common level of the two unwanted signals, to a specified level of the wanted signal at the receiver input, for which the message acceptance ratio is 80 %.

9.10.2 Method of measurement

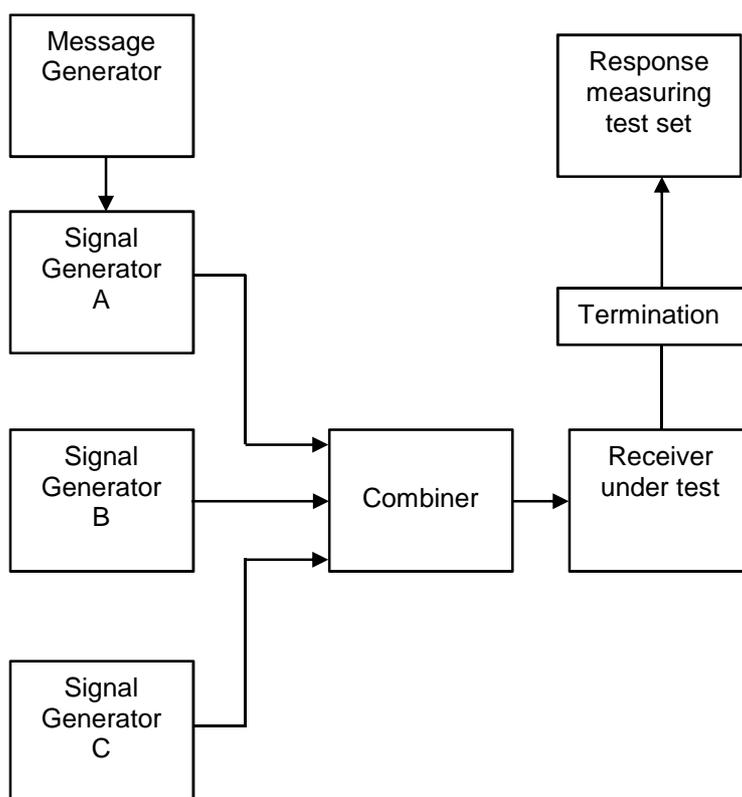


Figure 14: Measuring arrangement

Three signal generators, A, B and C, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated by the test signal D-M3 (see clause 6.1.2).

The signal level of generator A shall be 6 dB μ V emf. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The unwanted signal, represented by generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the nominal frequency. The second unwanted signal, modulated by the test signal A-M3 (see clause 6.1.1) and represented by signal generator C, shall be adjusted to a frequency 100 kHz above the nominal frequency.

The wanted signal shall then be transmitted repeatedly and signal generators B and C shall be switched on. The output levels of the two signal generators shall be maintained equal and adjusted to a value such that a successful message ratio of less than 10 % is obtained.

The levels of the unwanted signals shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be measured. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted input signals shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. 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 signals shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded, unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

The intermodulation immunity for messages shall be recorded as the ratio in dB of the average of the levels of the unwanted signals, to the level of the wanted input signal.

The measurements shall be repeated with the unwanted signal (generator B) at a frequency 50 kHz below that of the wanted signal and the frequency of the unwanted modulated signal (generator C) at a frequency 100 kHz below that of the wanted signal.

9.10.3 Limit

The intermodulation immunity shall not be less than 60 dB.

9.11 Blocking immunity or desensitization for analogue speech

9.11.1 Definition

The blocking immunity or desensitization for analogue speech is a measure of the capability of the receiver to receive a wanted modulated signal at the nominal frequency, without exceeding a given degradation due to the presence of an unwanted unmodulated high input signal, which is not a direct spurious frequency of the receiver under test.

It is specified as the ratio in dB, of the level of the unwanted signal to a specified level of the wanted signal which produces through a psophometric weighting network a SINAD ratio of 14 dB (blocking immunity), or a power reduction of 3 dB in the receiver audio output power (desensitization).

9.11.2 Method of measurement

The measuring arrangement shown in figure 13 shall be used.

Two signal generators, A and B, shall be connected to the receiver input via a combining network. The wanted signal, represented by generator A, shall be at the nominal frequency and modulated by the test signal AM-1 (see clause 6.1.1). The signal level of generator A shall be 6 dB μ V emf. This level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The unwanted signal, represented by generator B, shall be at least 1 MHz away from the nominal frequency signal and the level shall be increased until a reduction of the receiver audio output power, or a reduction of the SINAD is observed.

The level shall be kept constant and the frequency of the unwanted signal shall be varied over the range +1 MHz to +10 MHz and -1 MHz to -10 MHz relative to the nominal frequency of the receiver. The frequency at which the greatest degradation occurs shall be noted, ensuring that it is not a spurious frequency response.

The level of the unwanted signal shall then be adjusted to give:

- a reduction of 3 dB in the receiver audio output power; or
- a reduction to 14 dB SINAD ratio at the receiver audio output, whichever occurs first.

This level shall be measured. This input level is measured where the receiver input is to be connected but while the receiver input remains unconnected.

The blocking ratio or desensitization for analogue speech shall be recorded as the ratio in dB between the level of the unwanted signal to the level of the wanted signal, at the receiver input.

9.11.3 Limit

The blocking immunity shall not be less than 70 dB.

9.12 Blocking immunity or desensitization for messages

9.12.1 Definition

The blocking immunity or desensitization for messages is a measure of the capability of the receiver to receive a wanted modulated signal at the nominal frequency, without exceeding a given degradation due to the presence of an unwanted, unmodulated, high input signal, which is not a direct spurious frequency of the receiver under test.

It is specified as the ratio in dB of the level of the unwanted signal, to a specified level of the wanted signal at the receiver input, for which the message acceptance ratio is 80 %.

9.12.2 Method of measurement

The measuring arrangement shown in figure 13 shall be used.

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

Initially the unwanted signal, represented by the signal generator B, shall be switched off and the amplitude of signal generator A shall be adjusted to +6 dB μ V emf. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The wanted signal shall then be transmitted repeatedly and signal generator B shall be switched on. The unwanted signal shall be unmodulated and its frequency shall be selected in the range +1 MHz \pm 10 % relative to the nominal frequency of the receiver. This frequency shall be one at which no spurious response occurs. This level shall then be adjusted until a successful message ratio of less than 10 % is obtained.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be measured. This level is measured where the receiver input is to be connected, but while the receiver input remains unconnected.

The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. 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 signals shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

The measurements shall be repeated at a frequency of the unwanted signal selected in the range -1,0 MHz \pm 10 % relative to the nominal frequency of the receiver.

The blocking ratio or desensitization for messages speech shall be recorded as the ratio in dB between the level of the unwanted signal to the level of the wanted signal, at the receiver input.

9.12.3 Limit

The blocking immunity shall not be less than 70 dB.

9.13 Spurious emissions

9.13.1 Definition

Spurious emissions are discrete radio frequency signals conveyed from the antenna socket by conduction or radiated by the receiver.

They are specified as the power level of any discrete signal measured by the measuring device within the specified frequency range.

9.13.2 Method of measurement

9.13.2.1 Conducted spurious components

The receiver input terminals shall be connected to a measuring receiver having an input impedance of 50 Ω and the receiver under test shall be switched on.

The frequency of the measuring receiver shall be adjusted over the specified frequency range of 9 kHz to 4 GHz. The frequency and the absolute power level of each of the spurious components found shall be recorded.

The measuring receiver used shall have sufficient dynamic range and sensitivity to achieve the required measurement accuracy at the specified limit.

9.13.2.2 Radiated spurious components

On a test site, fulfilling the requirements of clause 6.4, the sample shall be placed at the specified height on the support. The receiver shall be switched on.

The radiation of any spurious components shall be detected by the test antenna and receiver over the frequency range of 25 MHz to 4 GHz.

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

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

9.13.3 Limits

The power of any spurious component shall not exceed:

- 2 nW in the range 9 kHz to 1 GHz; and
- 20 nW in the range 1 GHz to 4 GHz.

10 Measurement uncertainties

10.1 General

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

- the measured value related to the corresponding limit shall be used to decide whether an equipment meets the requirements of the present document;

- the value of the measurement uncertainty for the measurement of each parameter shall be separately included in the test report;
- the value of the measurement uncertainty shall be for each measurement, equal to or less than the figures below.

10.2 Measurement Uncertainty Values

Valid up to 1 GHz for RF parameters unless otherwise stated:

- RF frequency $\pm 1 \times 10^{-7}$
- RF power ± 2 dB

Maximum Frequency deviation:

- within 300 Hz to 6 kHz of audio frequency ± 5 %
- within 6 kHz to 25 kHz of audio frequency ± 3 dB
- Deviation limitation ± 5 %
- Sensitivity at 20 dB SINAD ± 3 dB
- Radiated emission of transmitter, valid to 4 GHz ± 6 dB
- Radiated emission of receiver, valid to 4 GHz ± 6 dB
- Transmitter intermodulation ± 6 dB

10.3 Calculation Methodology

For the test methods, according to the present document the uncertainty figures should be calculated according to the methods described in the ETSI TR 100 028 [i.7] 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 case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

The figures above are based on such expansion factors.

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

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] to provide one voluntary 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 and repealing Directive 1999/5/EC [i.1].

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

Harmonised Standard ETSI EN 300 224				
Requirement			Requirement Conditionality	
No	Description	Reference: Clause No	U/C	Condition
1	Transmitter frequency error	7.1	U	
2	Transmitter conducted and effective radiated power	7.2	U	
3	Transmitter adjacent and alternate channel power	7.3	U	
4	Transmitter frequency deviation	7.4	U	
5	Transmitter unwanted emissions in the spurious domain	7.5	U	
6	Transmitter transient behaviour	7.6	U	
7	Transmitter maximum transmit time	7.7	U	
8	Pager Receiver sensitivity	8.1.1	U	
9	Pager Receiver adjacent channel selectivity	8.2	U	
10	Pager Receiver co-channel rejection	8.3	U	
11	Pager Receiver inter-modulation response rejection	8.4	U	
12	Pager Receiver spurious response rejection	8.5	U	
13	Pager Receiver spurious emissions	8.6	U	
14	Base Receiver sensitivity for speech	9.1	U	
15	Base Receiver sensitivity for messages	9.2	U	
16	Base Receiver co-channel rejection for speech	9.3	U	
17	Base receiver co-channel rejection for messages	9.4	U	
18	Base Receiver adjacent channel rejection for speech	9.5	U	
19	Base Receiver adjacent channel rejection for messages	9.6	U	
20	Base Receiver spurious response immunity for speech	9.7	U	
21	Base Receiver spurious response immunity for messages	9.8	U	
22	Base Receiver inter-modulation response for speech	9.9	U	
23	Base Receiver inter-modulation response for messages	9.10	U	
24	Base Receiver blocking immunity speech	9.11	U	
25	Base Receiver blocking immunity messages	9.12	U	
26	Base Receiver spurious emissions	9.13	U	

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 is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).
Condition	Explains the conditions when the requirement is or is not 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 frequently consult 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.

Annex B (normative): Radiated measurements

B.1 Test site and general arrangements for measurements involving the use of radiated fields

B.1.1 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. Further detailed verification procedures and equipment requirements are described in ETSI TS 103 052 [i.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.

B.1.2 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 B.1.

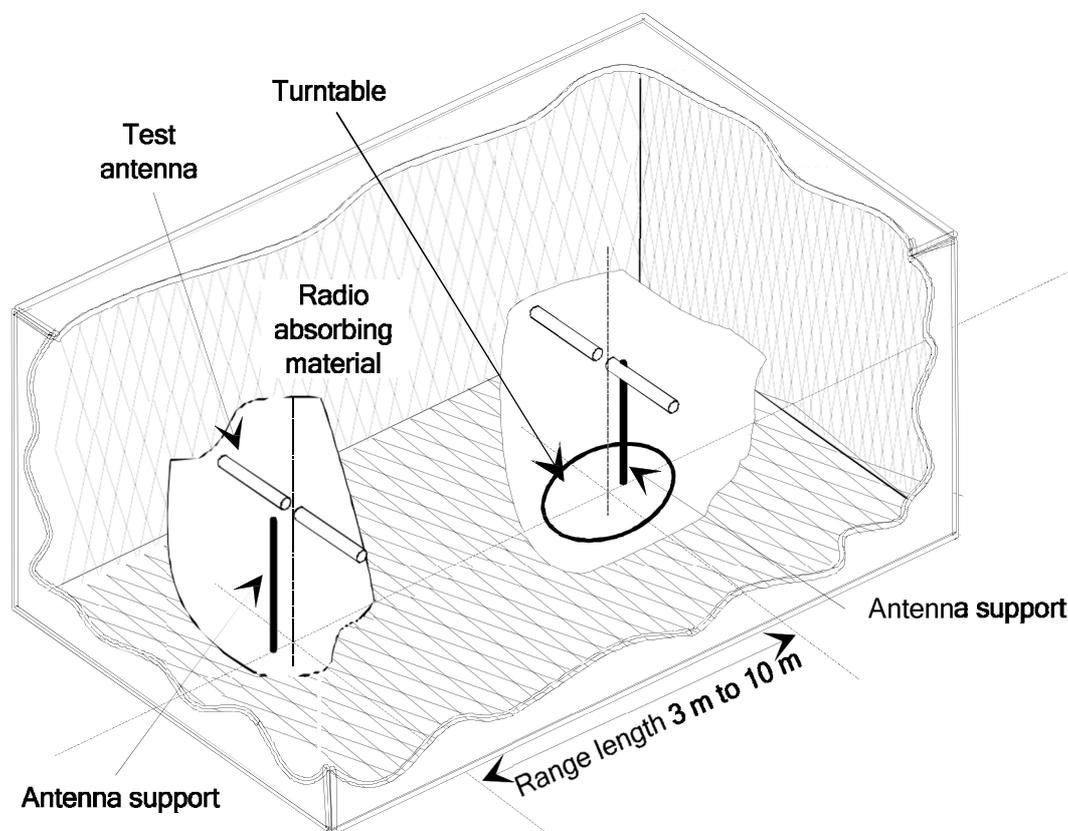


Figure B.1: A typical anechoic chamber

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 B.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.

B.1.3 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 B.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.

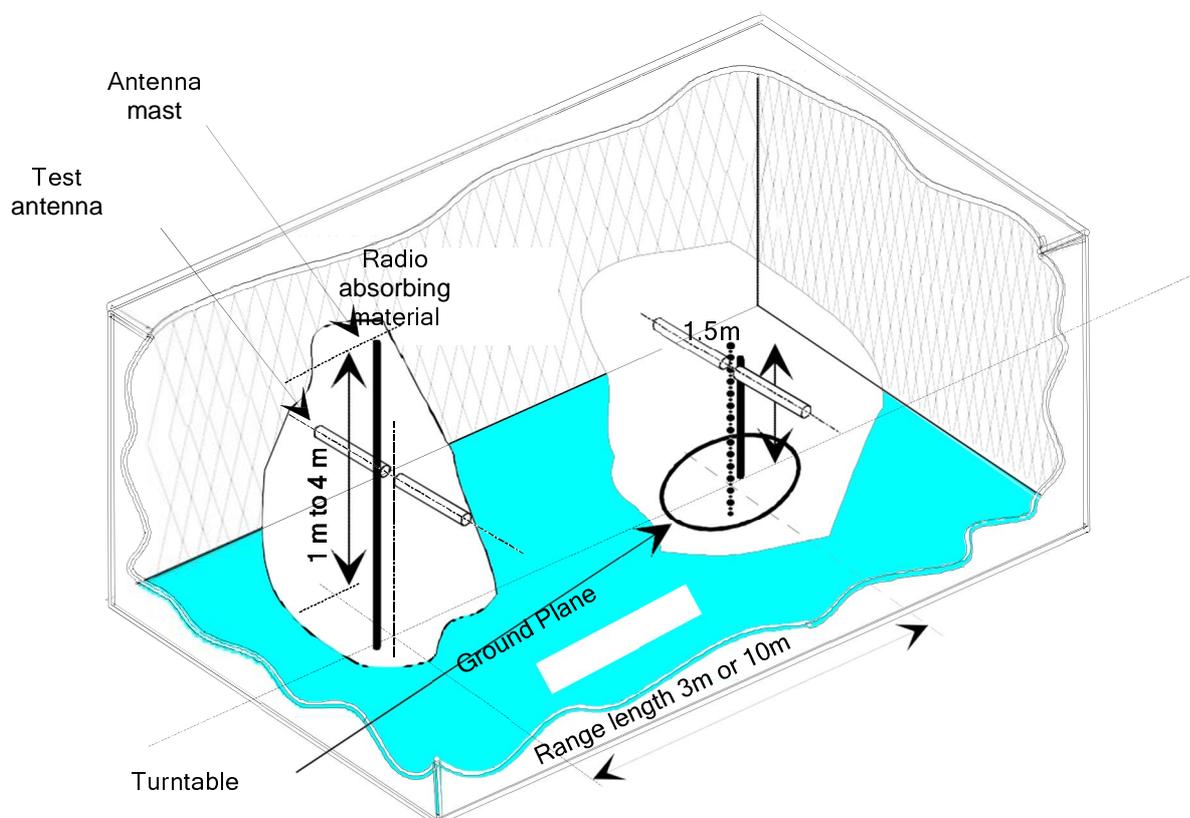


Figure B.2: A typical anechoic chamber with a conductive ground plane

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 $2(d_1 + d_2)/\lambda$ (m), whichever is greater (see clause B.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.

B.1.4 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 B.3.

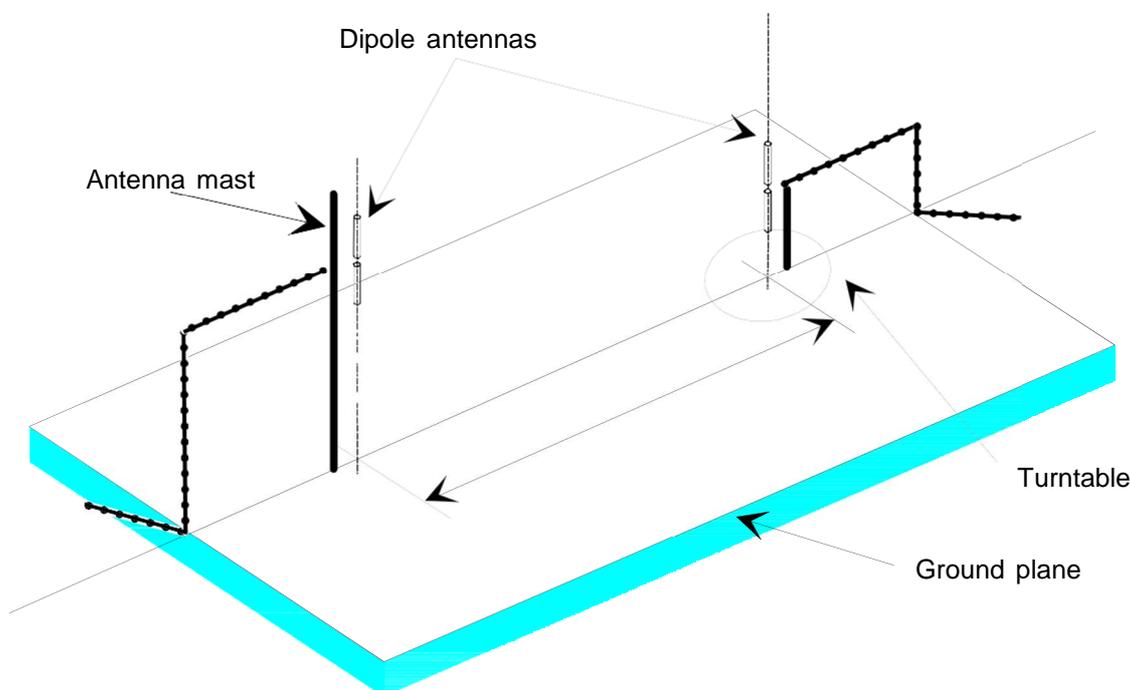


Figure B.3: A typical Open Area Test Site

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.

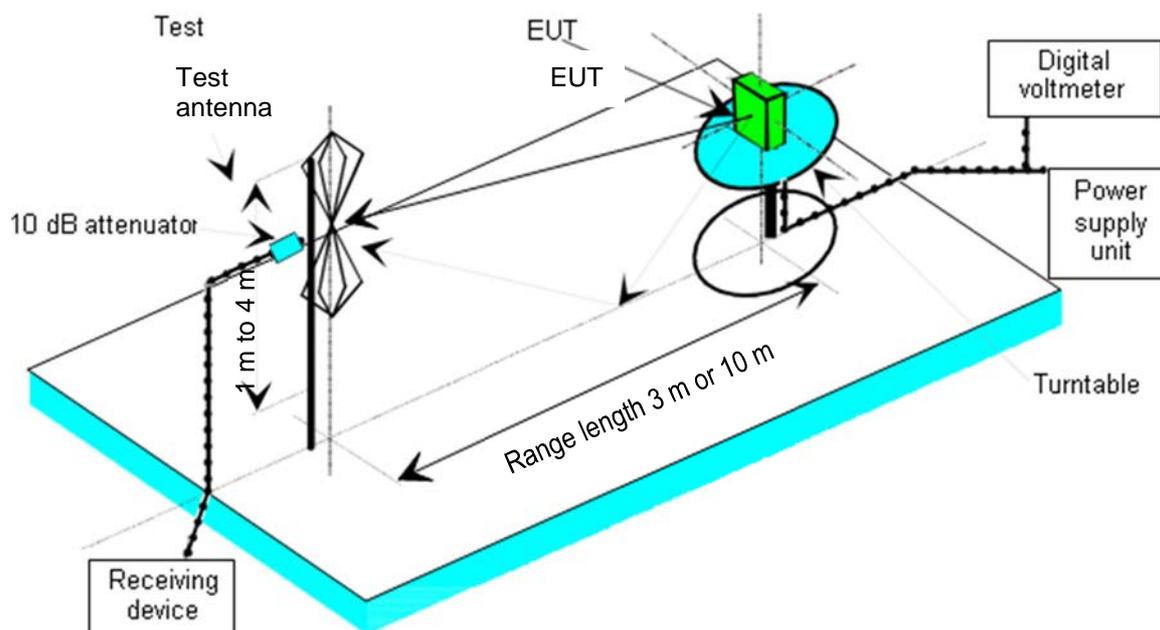


Figure B.4: Measuring arrangement on ground plane test site (OATS set-up for spurious emission testing)

B.1.5 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 [i.9]) 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 bi-conical 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 GHz band. Above 1 GHz, 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.

B.1.6 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 GHz, the substitution antenna should be a dipole antenna (constructed in accordance with ANSI C63.5 [i.9]). 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 GHz, a waveguide horn is recommended. The centre of this antenna should coincide with either the phase centre or volume centre.

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

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

NOTE: The gain of a horn antenna is generally expressed relative to an isotropic radiator by the horn manufacturer's data. This data should be corrected and referenced to that of a $\lambda/2$ dipole. It is assumed that the gain of a $\lambda/2$ dipole relative to an isotropic radiator is +2,2 dBi.

Therefore, the calculation is as follows:

$$\text{erp} = \text{Ps} - \text{C} + \text{A},$$

where:

- Ps = Power level of the signal generator;
- C = Coaxial cable loss (signal generator to antenna);
- A = Antenna gain (relative to $\lambda/2$ dipole) = dBd;
- dBd = dBi - 2,2.

B.1.7 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 GHz, the measuring antenna should be a dipole antenna (constructed in accordance with ANSI C63.5 [i.9]). 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.

B.2 Guidance on the use of radiation test sites

B.2.0 General

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

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 B.

B.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 B (i.e. Anechoic Chamber, Anechoic Chamber with a ground plane and Open Area Test Site) are given in ETSI TS 103 052 [i.4].

B.2.2 Preparation of the EUT

The manufacturer 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.

B.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).

B.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.

B.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 manufacturer. 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.

B.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: $\pm 0,5$ 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.

B.3 Coupling of signals

B.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).

B.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.

B.3.3 Speech and analogue signals

B.3.3.1 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.

B.3.3.2 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 manufacturer, 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 and 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.8], appendix F).

B.3.3.3 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.

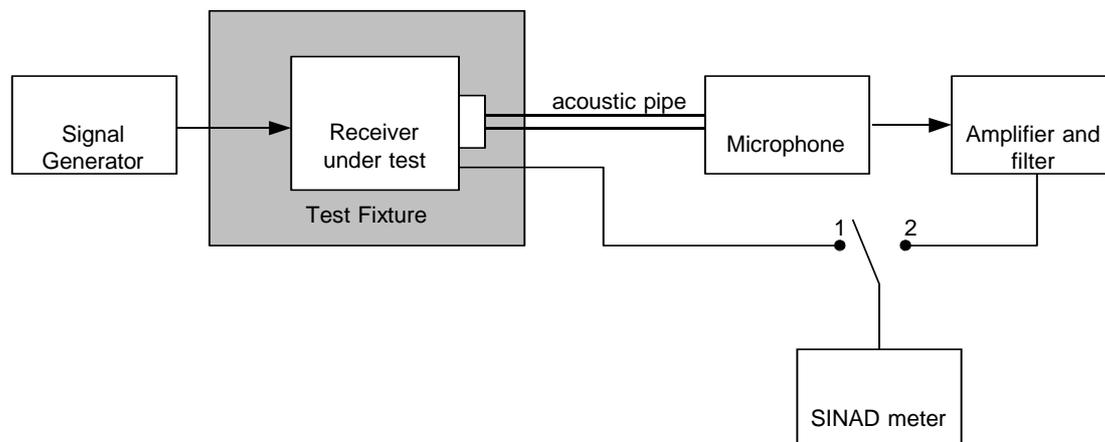


Figure B.5: Measuring arrangement for calibration

- The acoustic coupler shall be mounted to the equipment, if necessary using a test fixture. A direct electrical connection to the terminals of the output transducer will be made. A signal generator shall be connected to the receiver input (or to the test fixture input). The signal generator shall be at the nominal frequency of the receiver and shall be modulated by the normal test modulation.
- Where possible, the receiver volume control shall be adjusted to give at least 50 % of the rated audio output power and in the case of stepped volume controls, to the first step that provides an output power of at least 50 % of the rated audio output power.
- The test signal input level shall be reduced until an electrical SINAD ratio of 20 dB is obtained, the connection being in position 1. The signal input level shall be recorded.
- With the same signal input level, the acoustic equivalent SINAD ratio shall be measured and recorded, the connection being in position 2.

- e) Steps c) and d) above shall be repeated for an electrical SINAD ratio of 14 dB, and the acoustic equivalent SINAD ratio measured and recorded.

B.4 Test fixture

B.4.1 Description

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 shall provide:

- a connection to an external power supply;
- an audio interface either by direct connection or by an acoustic coupler. The test fixture normally shall be provided by the manufacturer.

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

- the coupling loss shall not be greater than 30 dB;
- a coupling loss variation over the frequency range used in the measurement which does not exceed 2 dB;
- circuitry associated with the RF coupling shall contain no active or non-linear devices;
- the VSWR at the 50 Ω socket, shall not be greater than 1,5 over the frequency range of the measurements;
- the coupling loss shall be independent of the position of the test fixture and be unaffected by the proximity of surrounding objects or people. The coupling loss shall be reproducible when the equipment under test is removed and replaced;
- the coupling loss shall remain substantially constant when the environmental conditions are varied.

In the case of measurements to be performed by a third party, the performance characteristics of the test fixture shall be approved by the testing laboratory.

The characteristics and calibration shall be included in test reports.

B.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 inside the test fixture.

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

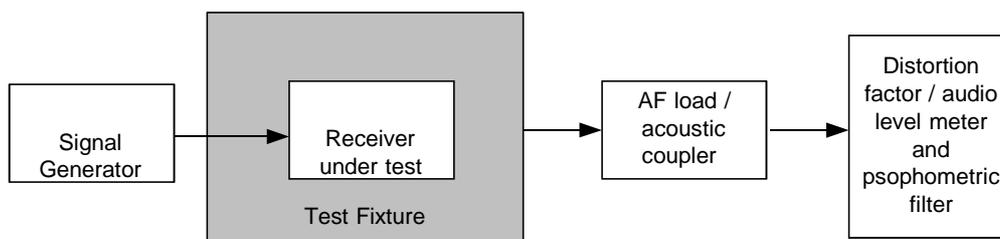


Figure B.6: Measuring arrangement for calibration

- Using the method described in clause 8.1.2.1, measure the sensitivity expressed as field strength, and note the value of this field strength in dB μ V/m and the polarization used.

- b) The receiver is now placed in the test fixture which is connected to the signal generator. The level of the signal generator producing a SINAD of 20 dB shall be noted.
- c) The calibration of the test fixture is thus the linear relationship between the field strength in dB μ V/m and the signal generator level in dB μ V emf or dBm.

B.4.3 Mode of use

For the transmitter measurements calibration is not required.

For the receiver measurements calibration is necessary.

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 with the signal generator.

Annex C (normative): Specification for power measuring receiver

C.0 General

The power measuring receiver consists of a mixer, an IF filter, an oscillator, an amplifier, a variable attenuator and a root mean squared (rms) value indicator.

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 below.

C.1 IF filter

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

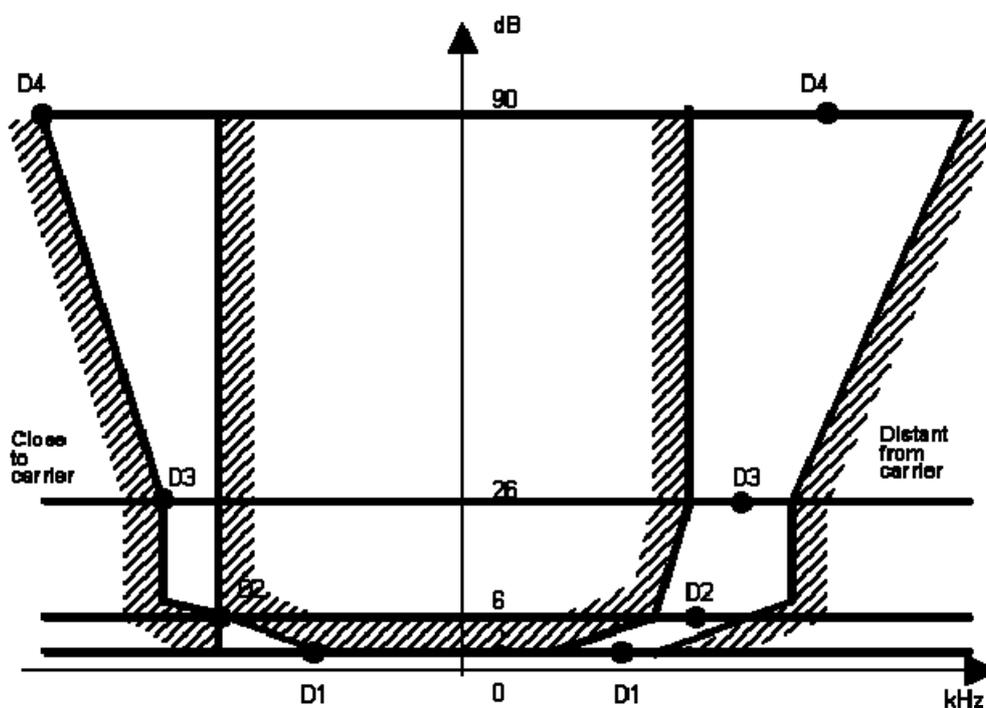


Figure C.1: IF filter

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 C.1.

Table C.1: Selectivity characteristic

Channel separation (kHz)	Frequency separation of filter curve from nominal centre frequency of adjacent channel (kHz)			
	D1	D2	D3	D4
10/12,5	3	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 C.2 and C.3.

Table C.2: Attenuation points close to carrier

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

Table C.3: Attenuation points distant from the carrier

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

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

C.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.

C.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.

C.4 Oscillator and amplifier

The oscillator and the amplifier shall be designed in such a way that the measurement of the adjacent channel power of a low-noise unmodulated transmitter, whose self-noise has a negligible influence on the measurement result, yields a measured value of ≤ -90 dB for channel separations of 20 kHz and 25 kHz and of ≤ -80 dB for a channel separation of 10 kHz and 12,5 kHz, referred to the carrier of the oscillator.

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

Annex D (normative): Band-stop filter (for SINAD meter)

The characteristics of the band-stop filter used in the audio distortion factor meter and SINAD meter should be such that at the output the 1 000 Hz tone will be attenuated by at least 40 dB and at 2 000 Hz the attenuation will not exceed 0,6 dB. The filter characteristic shall be flat within 0,6 dB over the ranges 20 Hz to 500 Hz and 2 000 Hz to 4 000 Hz. In the absence of modulation, the filter shall not cause more than 1 dB attenuation of the total noise power of the audio frequency output of the receiver under test.

Annex E (informative): Change history

Version	Information about changes
2.1.1	Revision under RE-D. Scope changed to include both wide area and on-site radio systems and to remove low frequency loop system requirements.

History

Document history		
Edition 1	May 1994	Publication as ETSI ETS 300 224
Amendment 1	November 1996	Amendment 1 to 1 st Edition of ETSI ETS 300 224
Edition 2	March 1998	Publication as ETSI ETS 300 224
V1.3.1/V1.1.1	January 2001	Publication as ETSI EN 300 224 part 1 and part 2
V2.0.0	March 2017	EN Approval Procedure AP 20170625: 2017-03-27 to 2017-06-26
V2.1.1	June 2017	Publication