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Foreword

This ETSI Technical Report (ETR) has been prepared by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies, but which are not suitable for adaption as formal standards (ETSs or I-ETSs).

It contains several methods of measurement which may be superseded by specific standards covering specific applications. It is based upon a number of CEPT Recommendations including T/R 24-01 and T/R 34-01.

The methods of measurement have been thoroughly revised and harmonised. However, the methods of measurement for radiated measurements presented in Clauses 3.3 and 5 are not definitive over issues of ground plane characteristics, antenna separation, antenna heights, antenna types, cable positions and most important of all, site calibration. Further work is being carried out. The corresponding results will be incorporated in a future release of this report.

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1 Scope

These methods of measurement are intended for use in determining the characteristics considered necessary to make the best use of the available frequencies in the mobile radio service. The intention is to give guidance to manufacturers and type testing authorities in order that common methods are adopted so that mutual acceptance of test results becomes possible. The equipment parameter limits can be found in the relevant ETS. To this end the philosophy has been adopted that for any specific test only one method of measurement should be described to assist in the maintenance of uniformity.

The methods apply to constant envelope frequency modulated or phase modulated systems as chosen by each administration operating on radio frequencies between 25 MHz and 1000 MHz and with channel separations of 12.5 kHz, 20 kHz and 25 kHz. Methods are described which are applicable to equipments capable of transmission and reception of analogue speech, bit stream and messages. For data, when possible, bit stream measurements shall be preferred to messages.

Included are methods of measurement for equipments fitted with antenna sockets, temporary 50 Ω connectors and integral antenna. Wherever possible, if the characteristics are not expected to be affected, the measurements shall be made by use of a direct connection to the equipment under test (antenna socket or temporary 50 Ω connector) as stated in each ETS, in order to ensure that the measurement uncertainties are minimised.

In the methods of measurement any different requirements are given for the different radio frequency bands, channel separations, etc., where appropriate.

A section defining terms used in this document not in common usage is to be found at Clause 2. These terms appear in the text in *italics*.

In Clause 3 reference is made to general arrangements of test equipment, test fixtures, test sites etc. When reference is made in the text to a particular feature in this section then it appears in bold type.

2 Abbreviations and definitions

2.1 Abbreviations

AF: Audio frequency

CCITT: International Telegraph and Telephone Consultative Committee

D: Distance in metres from equipment under test to the point at which measurements are made

emf: Electromotive force

ETS: European Telecommunication Standard

IF: Intermediate frequency

NaCl: Sodium chloride

RF: Radio frequency

rms: Root mean square

Rx: Receiver

SINAD: Signal plus noise and distortion divided by noise plus distortion

Tx: Transmitter

VSWR: Voltage standing wave ratio

2.2 Definitions

2.2.1 *Audio frequency load*

The *audio frequency* load is normally a resistor of sufficient power rating to accept the maximum audio output power from the equipment under test. The value of the resistor shall be that stated by the manufacturer and shall be the impedance of the audio transducer at 1000 Hz. In some cases it may be necessary to place an isolating transformer between the output terminals of the receiver under test and the load.

2.2.2 *Audio frequency termination*

The *audio frequency terminatio*n is any connection other than the *audio frequency load* which may be required for the purpose of testing the receiver. (i.e. in a case where it is required that the bit stream be measured, the connection may be made, via a suitable interface, to the discriminator of the receiver under test).

The termination device shall be agreed between the manufacturer and the testing authority and details shall be included in the test report. If special equipment is required then it shall be provided by the manufacturer.

2.2.3 *Band-stop filter (for the SINAD meter)*

The characteristics of the *band-stop filter* used in the audio distortion factor meter and SINAD meter shall be such that at the output the 1000 Hz tone will be attenuated by at least 40 dB and at 2000 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 2000 Hz to 4000 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.

2.2.4 *Combining network*

The *combining network* is a multipole network allowing the addition of two or more test signals produced by different sources for connection to a receiver input. Sources of test signals shall be connected in such a way that the impedance presented to the receiver shall be 5O Ω. The effects of any intermodulation products and noise produced in the signal generators should be negligible.

2.2.5 *Duplex filter*

The *duplex filter* is a device fitted internally or externally to a transmitter/receiver combination to allow simultaneous transmission and reception with a single antenna connection.

2.2.6 *Extreme test conditions*

The *extreme test condition*s are defined in terms of temperature and supply voltage. Tests shall be made with the extremes of temperature and voltage applied simultaneously. The upper and lower temperature limits are specified in the relevant ETS. The test report shall state the actual temperatures measured.

When extreme temperatures are applied to the equipment, provisions have to be made so that thermal balance has been reached and that condensation does not occur. Further details will be specified in the relevant ETS.

The extreme test voltage for equipment to be connected to an AC supply shall be the *nominal mains voltage* ± 10 %.

The extreme test voltages for equipment intended for use with lead acid batteries fitted on vehicles and charged from a regulator shall be 0.9 and 1.3 times the nominal voltage of the battery.

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

[1] For the Leclanché or lithium type of cell, 0.85 times the nominal voltage of the battery.

[2] For the mercury or nickel-cadmium type of cell, 0.9 times the nominal voltage of the battery.

[3] For other types of batteries, the end point voltage declared by the equipment manufacturer.

The upper extreme test voltage shall be the nominal voltage of the battery.

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 type testing authority and shall be recorded with the results.

2.2.7 *Intermittent operation*

The manufacturer shall state the maximum time that the equipment is intended to transmit and the necessary standby period before repeating a transmit period.

2.2.8 *Limited Frequency Range*

The *limited frequency range* is a specified smaller frequency range within the full frequency range over which the measurement is made.

The details of the calculation of the *limited frequency range* shall be given in the relevant ETS.

The *limited frequency range* shall be used in the measurement of receiver spurious response immunity to enable a detailed search for responses close to the wanted frequency.

Outside the *limited frequency range* the receiver spurious response immunity shall be measured at frequencies where it is calculated that a spurious response could occur.

2.2.9 *Maximum permissible frequency deviation*

The *maximum permissible frequency deviation* is the maximum value of frequency deviation stated for the relevant channel separation and is shown in the table below:

Table 1

Channel Separation (kHz)	Maximum permissible frequency deviation (kHz)
12.5	± 2.5
20.0	± 4.0
25.0	± 5.0

NOTE: The above values of deviation are equal to 20 % of the channel separation.

2.2.10 *Nominal frequency*

A *nominal frequency* is defined as one of the channel frequencies on which the equipment is designed to operate.

2.2.11 *Nominal mains voltage*

The *nominal mains voltage* is the declared voltage or any of the declared voltages for which the equipment was designed.

2.2.12 *Normal test conditions*

The *normal test conditions* are defined in terms of temperature, humidity and supply voltage.

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 %

The actual temperature and humidity shall be recorded in the test report for each measurement.

If it is impractical to carry out the tests under the foregoing conditions,a note stating that the actual temperature and humidity were outside normal test conditions shall be added to the report.

The normal test voltage for equipment connected to the mains shall be the *nominal mains voltage*.
The frequency of the *nominal mains voltage* shall be between 49 and 51 Hz.

The normal test voltage for equipment intended for use with lead acid batteries fitted on vehicles and charged from a regulator shall be 1.1 times the nominal voltage of the battery. The nominal voltage of a lead acid cell shall be taken to be 2 volts.

If other power sources or types of battery (primary or secondary) are required for operation then the normal test voltage shall be that declared by the equipment manufacturer.

2.2.13 *Normal deviation*

The *normal deviation* is the frequency deviation for analogue signals which is equal to 12 % of the channel separation.

2.2.14 *Psophometric weighting network*

The *psophometric weighting network* shall be as described in CCITT Recommendation O.41.

2.2.15 *Rated audio output power*

The *rated audio output power* is the maximum output power under normal test conditions, and at standard test modulations (A-M1, see subclause 2.2.18), as declared by the manufacturer.

2.2.16 *Rated radio frequency output power*

The *rated radio frequency output power* is the maximum carrier power under normal test conditions, as declared by the manufacturer.

2.2.17 *Test load*

The *test load* is a 50 Ω substantially non-reactive, non-radiating power attenuator which is capable of safely dissipating the power from the transmitter.

2.2.18 *Test modulation*

The test modulating 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.

Signals for analogue speech:

***A-M1*:** A 1000 Hz tone at a level which produces a deviation of 12 % of the channel separation.

***A-M2*:** A 1250 Hz tone at a level which produces a deviation of 12 % of the channel separation.

***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.

Signals for data (bit stream):

The level of deviation used in digital measurements is system and method dependent (sub-carrier or direct modulation) and shall be agreed between the testing authority and the supplier. At no time will it exceed 20 % of the channel separation.

***D-M0*:** A signal representing an infinite series of '0' bits.

***D-M1*:** A signal representing an infinite series of '1' bits.

***D-M2*:** A signal representing a pseudorandom bit sequence of at least 511 bits in accordance with CCITT Recommendation O.153. This sequence shall be continuously repeated. This signal is used as a wanted signal. In the case of digital duplex measurements it is also used to modulate the transmitter but the sequence shall start at a different time from the signal modulating the receiver.

Signals for data (messages):

D-M3: A test signal shall be agreed between the testing authority and the manufacturer in the cases where it is not possible to measure a bit stream or if selective messages are used and are generated or decoded within an equipment. The agreed test signal may be formatted and may contain error detection and correction.

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

Details of the test signal shall be supplied in the test report.

2.2.19 *Trigger device*

A *trigger device* is a circuit or mechanism to trigger the oscilloscope timebase at the required instant. It may control the transmit function or inversely receive an appropriate command from the transmitter.

2.2.20 *Upper specified audio frequency limit*

The *upper specified audio frequency limit* is the maximum audio frequency of the audio pass-band and is dependent on the channel separation.

- For 20 and 25 kHz channel separated systems the limit is 3000 Hz;

- for 12.5 kHz channel separated systems the limit is 2550 Hz.

2.2.21 *Wanted signal level*

For conducted measurements the *wanted signal level* is defined as a level of +6 dB/µV emf referred to the receiver input under *normal test conditions.* Under *extreme test conditions* the value is +12 dB/µV emf.

For radiated measurements the *wanted signal* is defined as a field strength given in the following table

Table 2

Frequency Band (MHz)	Field strength in dB relative to 1 V/m	
	Normal test conditions	Extreme test conditions
25 to <100	14	20
100 to <230	20	26
230 to <470	26	32
470 to 1000	32	38

For analogue measurements the wanted signal level has been chosen to be equal to the limit value of the measured usable sensitivity.

For bit stream and message measurements the wanted signal has been chosen to be +3 dB above the limit value of measured usable sensitivity.

3 General arrangements

3.1 Power measuring receiver

3.1.1 Description

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

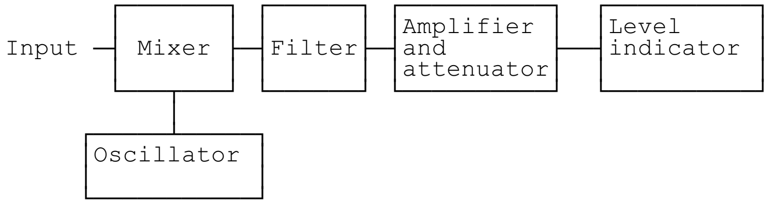


Figure 1

The technical characteristics of the **power measuring receiver** are given below.

3.1.2 I F filter

The I F filter shall be within the limits of the selectivity characteristics given in the following diagram. Depending on the channel separation, the selectivity characteristics shall keep the frequency separations and tolerances given in the following table. The minimum attenuation of the filter outside the 90 dB attenuation points must be equal to or greater than 90 dB.

NOTE: A symmetrical filter can be used provided that each side meets the tighter tolerances and the D0 points have been calibrated relative to the -6 dB response. When a non-symmetrical filter is used the receiver must be designed such that the tighter tolerance is used close to the carrier.

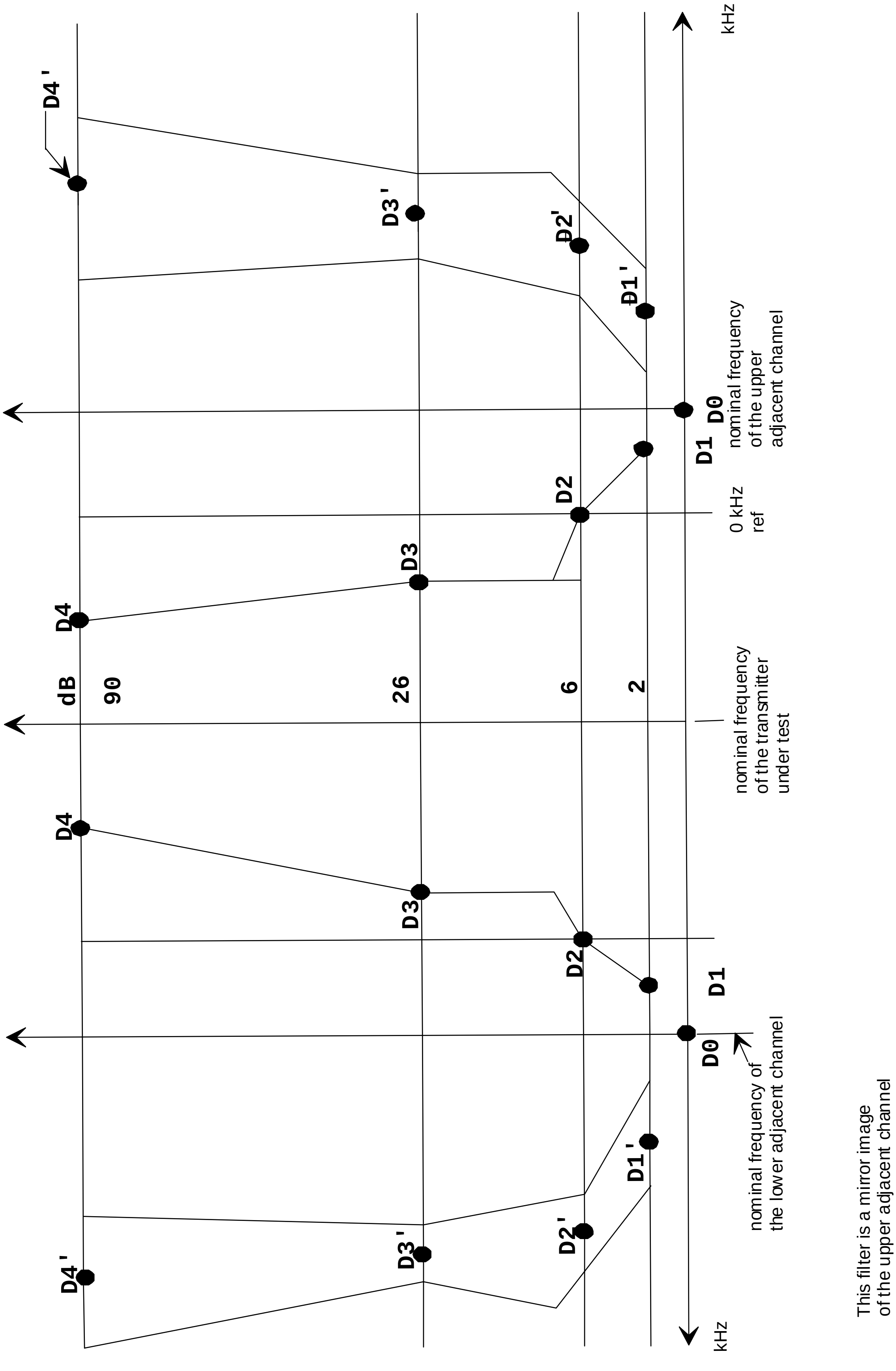


Figure 2: Power measuring filter shape

Power measuring filter shape

Point	Attenuation relative to passband (dB)	Distance in kHz from D2 (-6 dB ref.) for channel separations of:		
		12.5 kHz	20 kHz	25 kHz
D4	90	-5.25 *	-5.25 *	-5.25 *
D3	26	-1.25 *	-1.25 *	-1.25 *
D2	6	0	0	0
D1	2	1.25 *	3.00 *	3.00 *
D0	0. + 2	4.25 ± 0.1	7.00 ± 0.1	8.00 ± 0.1
D1'	2	7.25 ± 2.0	11.00 ± 3.0	13.00 ± 3.5
D2'	6	8.50 ± 2.0	14.00 ± 3.0	16.00 ± 3.5
D3'	26	9.75 ± 2.0	15.25 ± 3.0	17.25 ± 3.5
D4'	90	13.75 + 2.0 - 6.0	19.25 + 3.0 - 7.0	21.25 + 3.5 - 7.5

* These are maximum distances from the D2 reference.

D0 is the nominal centre of the template of the filter and may be used as the reference with respect to the nominal frequency of the adjacent channel.

3.1.3 Oscillator and amplifier

The measurement of the reference frequencies and the setting of the local oscillator frequency shall be within ± 50 Hz.

The mixer, oscillator and the amplifier shall be designed in such a way that the measurement of the adjacent channel power of an unmodulated test signal source, whose noise has a negligible influence on the measurement result, yields a measured value of ≤ -90 dB for channel separation of 20 and 25 kHz and of ≤ -80 dB for a channel separation of 12.5 kHz referred to the level of the test signal source.

The linearity of the amplifier shall be such that an error in the reading of no more than 1.5 dB will be obtained over an input level variation of 100 dB.

3.1.4 Attenuation indicator

The attenuation indicator shall have a minimum range of 80 dB and a resolution of 1 dB.

3.1.5 Level indicators

Two level indicators are required to cover the rms and the peak transient measurement.

3.1.5.1 Rms level indicator

The rms level indicator shall indicate non-sinusoidal signals accurately within a ratio of 10:1 between peak value and rms value.

3.1.5.2 Peak level indicator

The peak level indicator shall indicate accurately and store the peak power level. For the transient power measurement the indicator bandwidth shall be greater than twice the channel separation.

A storage oscilloscope or a spectrum analyser may be used as a peak level indicator.

3.2 Test Discriminator

The **test discriminator** consists of a mixer and local oscillator (auxiliary frequency) to convert the transmitter frequency to be measured into the frequency of a broadband limiter amplifier and of a broadband discriminator with the following characteristics:

- The discriminator shall be sensitive and accurate enough to cope with transmitter carrier powers as low as 1 mW.
- The discriminator must be fast enough to display the frequency deviation (approx. 100 kHz/100 µs).
- The discriminator output must be d.c. coupled.

3.3 Test Sites

Any of the following four **test site**s may be used.

3.3.1 Open Air Test Site

3.3.1.1 Description

The term "open air" must be understood from a electromagnetic point of view. Such a **test site** may be really in open air or alternatively with walls and ceiling transparent to radio waves at the frequencies under consideration.

An **open air test site** may be used to perform the measurements using the radiated measurement methods described in Clause 5. Absolute or relative measurements may be performed on transmitters or on receivers; absolute measurements of field strength require a calibration of the **test site**.

Measuring distances of 3 m, 5 m, 10 m, and 30 m are in common use. The equipment size (excluding the antenna) shall be less than 20 % of the measuring distance. The height of the equipment or of the **substitution antenna** shall be 1.5 m; the height of the **test antenna** (transmit or receive) shall vary between 1 and 4 m. The overall size of an **open air test site** is approximately 2D by 3D, where D is the measuring distance.

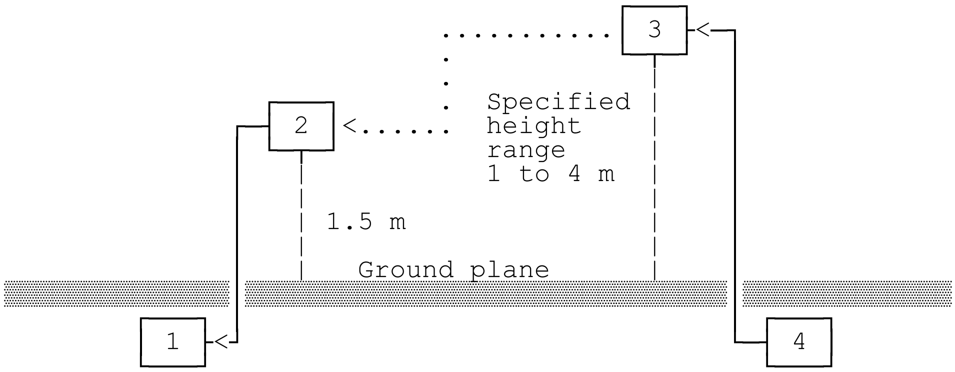
To eliminate errors caused by reflection coefficient variation from one measurement geometry to another, the standard ground plane should be substantially flat and horizontal; it should be made from a highly conductive, relatively non-ferrous metal. It must be large enough to provide consistent ground reflections. Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site do not degrade the measurement results, in particular:

- No extraneous conducting objects having any dimension in excess of a quarter wavelength of the highest frequency tested shall be in the immediate vicinity of the site;

- all cables shall be as short as possible; as much of the cables as possible shall be on the ground plane or preferably below; and the low impedance cables shall be screened.

3.3.1.2 Calibration

The calibration allows the creation, in a given place, of a known field strength by the means of a signal generator connected to a **test antenna**. The calibration is valid only at a given frequency for a given polarisation and for the exact position of the **test antenna**.



1: Selective voltmeter
2: Substitution antenna
3: Test antenna
4: Signal generator

Figure 3: Measuring arrangement for calibration

All the equipment shall be adjusted to the frequency at which the calibration is to be measured.

The **test antenna** and the **substitution antenna** shall have the same polarisation.

The **substitution antenna** connected to the selective voltmeter constitutes a calibrated field strength meter.

a) The signal generator level shall be adjusted to produce the required field strength as measured on the selective voltmeter.

b) The **test antenna** shall be raised or lowered through the specified range until the maximum signal level is detected on the selective voltmeter.

c) The signal generator level shall be readjusted to produce the required field strength as measured on the selective voltmeter. Thus a relationship has been established between the signal generator level and the field strength

3.3.2 Anechoic chamber

3.3.2.1 General

An **anechoic chamber** is a well shielded chamber covered inside with radio frequency absorbing material and simulating a free space environment. It is an alternative site on which to perform the measurements using the radiated measurement methods described in Clause 5. Absolute or relative measurements can be performed on transmitters or on receivers. Absolute measurements of field strength require a calibration of the **anechoic chamber**. The **test antenna**, equipment under test and **substitution antenna** are used in a way similar to that at the **open air test site**, but are all located at the same fixed height above the floor.

3.3.2.2 Description

An **anechoic chamber** should meet the requirements for shielding loss and wall return loss as shown in figure 4. Figure 5 shows an example of the construction of an **anechoic chamber** having a base area of 5 m by 10 m and a height of 5 m. The ceiling and walls are coated with pyramidally formed absorbers approximately 1 m high. The base is covered with special absorbers which form the floor. The available internal dimensions of the chamber are 3 m x 8 m x 3 m, so that a maximum measuring distance of 5 m in the middle axis of this chamber is available (see ZVEI AK-R 90/20 [4]. The floor absorbers reject floor reflections so that the antenna height need not be changed. **Anechoic chambers** of other dimensions may be used.

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

3.3.2.3 Influence of parasitic reflections

For free-space propagation in the far field the relationship of the field strength X and the distance R is given by $X = X_o \times (R_o/R)$, where X_o is the reference field strength and R_o is the reference distance. This relationship allows relative measurements to be made as all constants are eliminated within the ratio and neither cable attenuation nor antenna mismatch or antenna dimensions are of importance.

If the logarithm of the foregoing equation is used, the deviation from the ideal curve can be easily seen because the ideal correlation of field strength and distance appears as a straight line. The deviations occurring in practice are then clearly visible. This indirect method shows quickly and easily any disturbances due to reflections and is far less difficult than the direct measurement of reflection attenuation.

With an **anechoic chamber** of the dimensions given above at low frequencies below 100 MHz there are no far field conditions, but the wall reflections are stronger, so that careful calibration is necessary. In the medium frequency range from 100 MHz to 1 GHz the dependence of the field strength to the distance meets the expectations very well. Above 1 GHz, because more reflections will occur, the dependence of the field strength to the distance will not correlate so closely.

3.3.2.4 Calibration and Mode of use

The calibration and mode of use are the same as for an **open air test site**, the only difference being that the **test antenna** does not need to be raised and lowered whilst searching for a maximum, which simplifies the method of measurement.

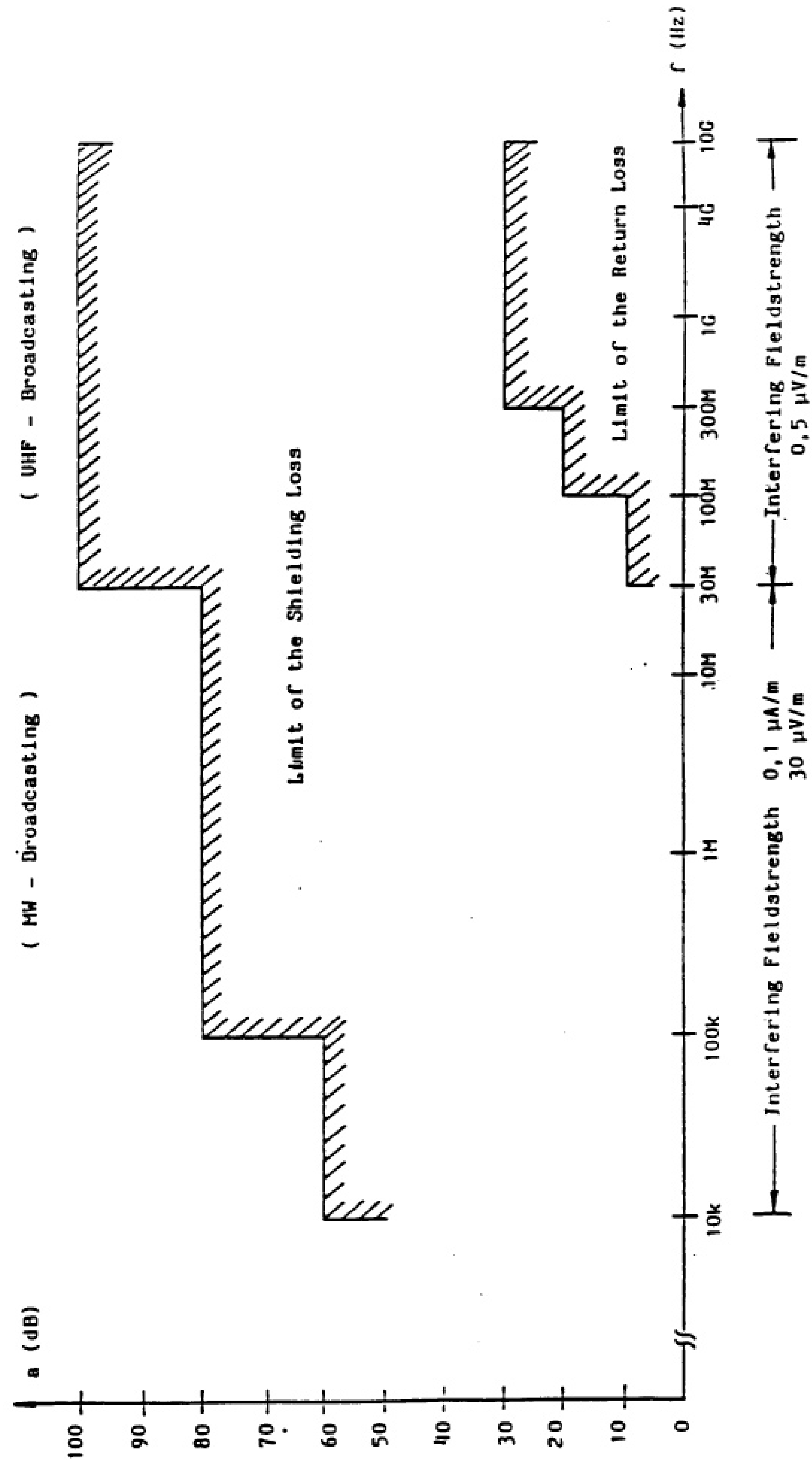


Figure 4: Electrical requirements for the shielded anechoic chamber for simulated free space measurements

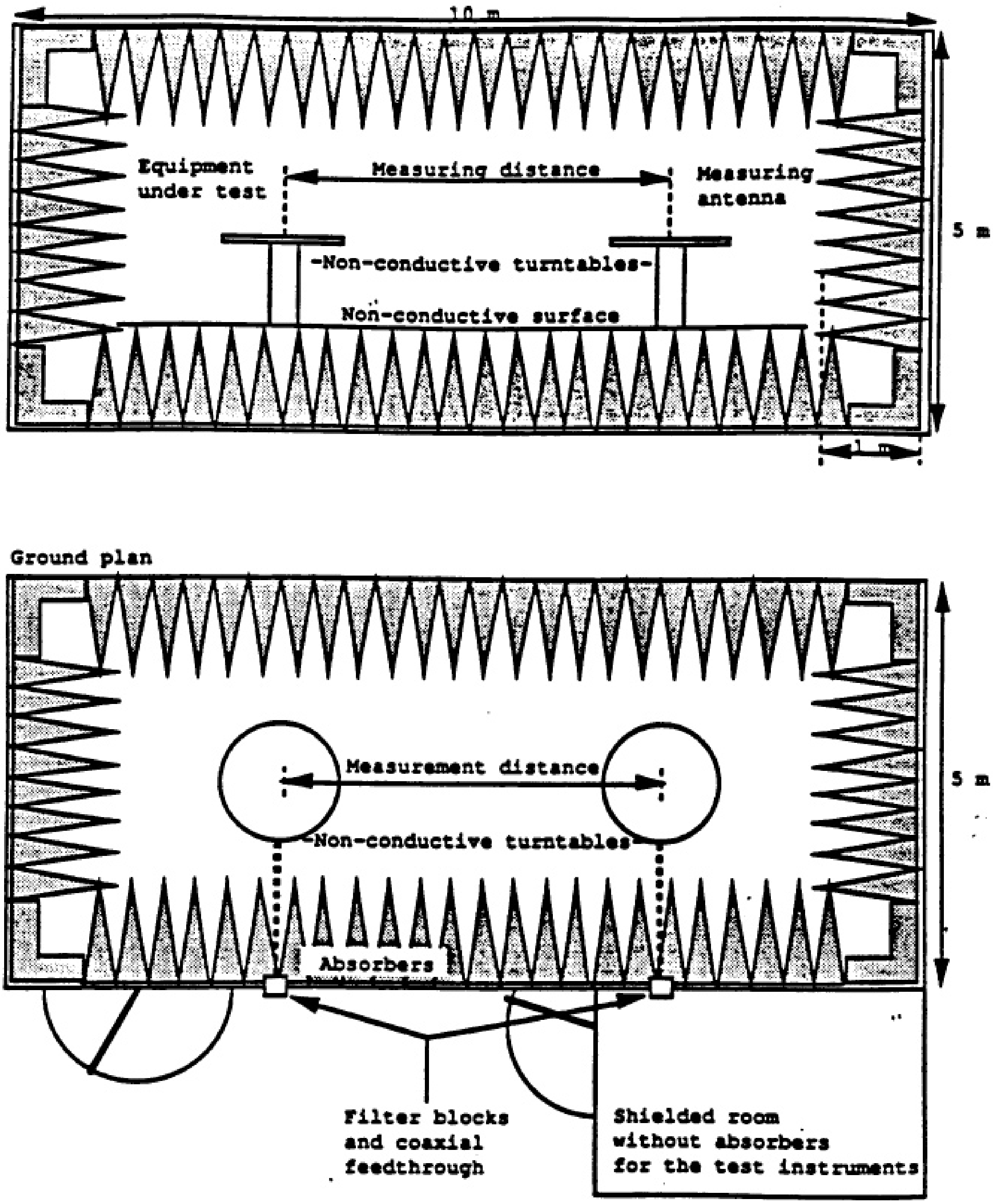


Figure 5: Anechoic shielded chamber for simulated free space measurements

3.3.3 Stripline Arrangement

3.3.3.1 General

The **stripline arrangement** is a RF coupling device for coupling the integral antenna of an equipment to a 50 Ω radio frequency terminal. This allows the radiated measurements described in Clause 5 to be performed without an **open air test site** but in a restricted frequency range. Absolute or relative measurements can be performed; absolute measurements require a calibration of the **stripline arrangement**.

3.3.3.2 Description

The stripline is made of three highly conductive sheets forming part of a transmission line which allows the equipment under test to be placed within a known electric field. They shall be sufficiently rigid to support the equipment under test.

Two examples of stripline characteristics are given below:

		IEC 489-3 App. F [2]	IEC 489-3 App. F [3]
Useful frequency range	MHz	1 to 200	0,1 to 4000
Equipment size limits	length	200 mm	1200 mm
(antenna included):	width	200 mm	1200 mm
	height	250 mm	400 mm

3.3.3.3 Calibration

The aim of calibration is to establish at any frequency a relationship between the voltage applied by the signal generator and the field strength at the designated test area inside the stripline.

3.3.3.4 Mode of use

The **stripline arrangement** may be used for all radiated measurements within its calibrated frequency range.

The method of measurement shall be the same as the method using a **open air test site** with the following change. The **stripline arrangement** input socket shall be used instead of the **test antenna**.

3.3.4 Indoor test site

3.3.4.1 Description

An **indoor test site** is a partially screened site, where the wall located behind the test sample is covered with a radio frequency absorbing material and a corner reflector is used with the **test antenna**. It may be used when the frequency of the signals being measured is greater than 80 MHz.

The measurement site may be a laboratory room with a minimum area of 6 m by 7 m and at least 2.7 m in height.

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

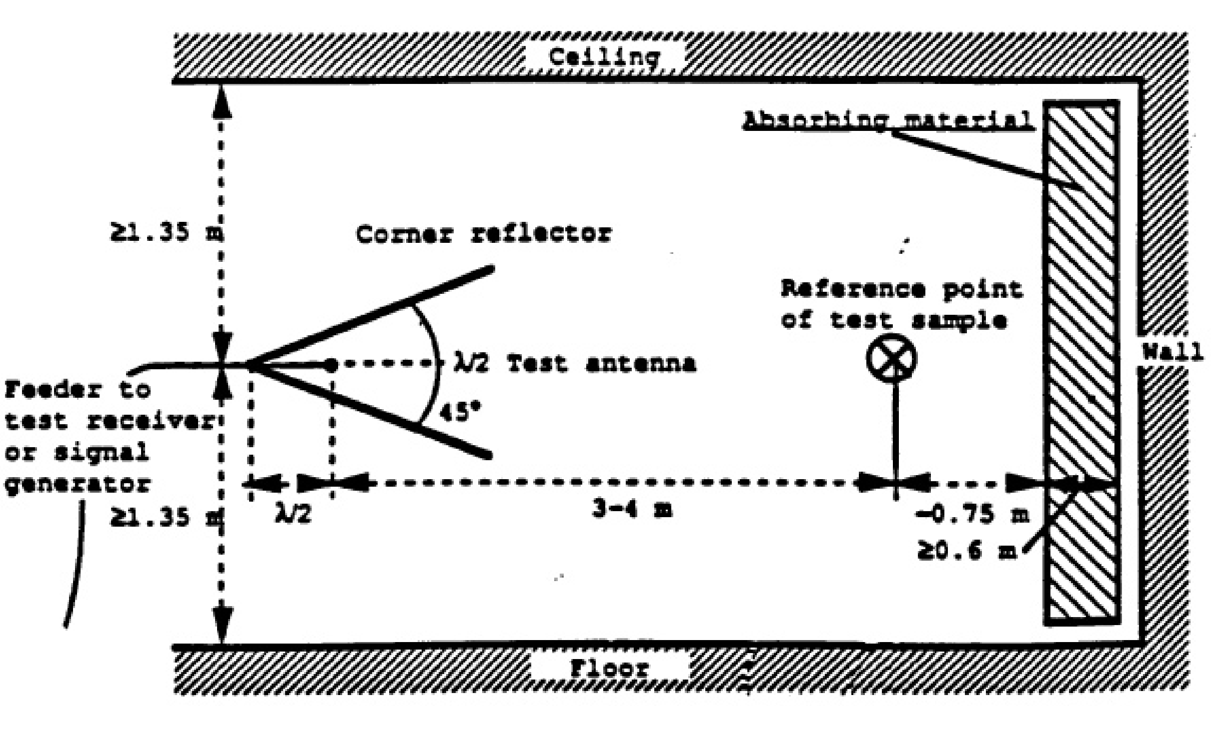


Figure 6: Indoor test site arrangement (shown for horizontal polarisation)

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

3.3.4.2 Test for parasitic reflections

To ensure that errors are not caused by the propagation path approaching the point at which phase cancellation between direct and the remaining reflected signals occurs, the **substitution antenna** shall be moved through a distance of ± 10 cm in the direction of the **test antenna** as well as in the two directions perpendicular to this first direction.

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

3.3.4.3 Calibration and mode of use

The calibration and mode of use is the same as for an **open air test site**, the only difference being that the **test antenna** does not need to be raised and lowered whilst searching for a maximum, which simplifies the method of measurement.

3.4 Standard Position

The **standard position** in all **test sites**, except the **stripline arrangement**, for equipment which is not intended to be worn on a person, including hand-held equipment, shall be on a non conducting support, height 1.5 m, capable of rotating about a vertical axis through the equipment. The **standard position** of the equipment shall be the following:

a) For equipment with an integral antenna, it shall be placed in the position closest to normal use as declared by the manufacturer.

b) For equipment with a rigid external antenna, the antenna shall be vertical.

c) For equipment with a non-rigid external antenna, the antenna shall be extended vertically upwards by a non-conducting support.

Equipment which is intended to be worn on a person may be tested using a simulated man as support.

The simulated man comprises a rotatable acrylic tube filled with salt water, placed on the ground.

The container shall have the following dimensions:

- Height 1,7 ± 0,1 m
- Inside diameter 300 ± 5 mm
- Sidewall thickness 5 ± 0.5 mm

The container shall be filled with a salt (NaCl) solution of 1.5 g per litre of distilled water.

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

NOTE: To reduce the weight of the simulated man it may be possible to use an alternative tube which has a hollow centre of 220 mm maximum diameter.

In the **stripline arrangement** the equipment under test or the **substitution antenna** is placed in the designated test area in the normal operational position, relative to the applied field, on a pedestal made of a low dielectric material (dielectric constant less than 2).

3.5 Acoustic coupler

3.5.1 General

When radiation measurements are performed, on the receiver, the audio output voltage should be conducted from the receiver to the measuring equipment, without perturbing the field near the receiver.

This perturbation can be minimised by using wires with high resistivity associated to a test equipment with a high input impedance (IEC 489-3 Appendix F [1]).

When this situation is not applicable, an **acoustic coupler** shall be used.

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

3.5.2 Description

The **acoustic coupler** comprises of a plastic funnel, an acoustic pipe and a microphone with a suitable amplifier.

- The acoustic pipe shall be long enough (e.g. 2 m) to reach from the equipment under test to the microphone which is located in a position that will not disturb the RF field. The acoustic pipe shall have an inner diameter of about 6 mm and a wall thickness of about 1.5 mm and should be sufficiently flexible to allow the platform to rotate.

- The plastic funnel shall have a diameter appropriate to the size of the loudspeaker in the equipment under test, with soft foam rubber glued to its edge, it shall be fitted to one end of the acoustic pipe and the microphone shall be fitted to the other end. It is very important to fix the centre of the funnel in a reproducible position relative to the equipment under test, 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 equipment in a close fitting acoustic mounting jig, supplied by the manufacturer, of which the funnel is an integral part.

- The microphone shall have a response characteristic flat within 1 dB over a frequency range of 50 Hz to 20 kHz, a linear dynamic range of at least 50 dB. The sensitivity of the microphone and the receiver audio output level shall be suitable to measure a signal to noise ratio of at least 40 dB at the nominal audio output level of the equipment under test. Its size should be sufficiently small to couple to the acoustic pipe.

- The frequency correcting network shall correct the frequency response of the **acoustic coupler** so that the acoustic SINAD measurement is valid, IEC 489-3 Appendix F [1].

3.5.3 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.

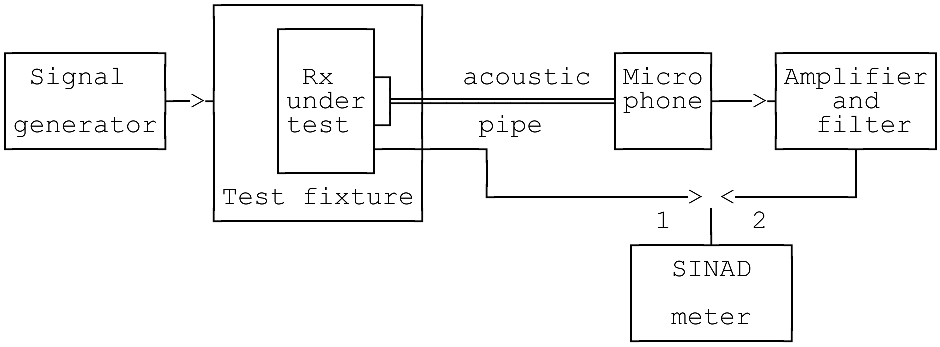


Figure 7: Calibration of the acoustic coupler

3.5.3.1 Measuring arrangement for calibration

a) 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 *test modulation A-M1*.

b) 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*.

c) 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.

d) 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.

3.6 Test Antenna

When the **test site** is used for radiation measurements the **test antenna** is used to detect the field from both the test sample and the **substitution antenna**. When the **test site** is used for the measurement of receiver characteristics the antenna is used as a transmitting antenna. This antenna is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarisation and for the height of its centre above the ground to be varied over the specified range. Preferably test antennas with pronounced directivity should be used. The size of the **test antenna** along the measurement axis shall not exceed 20 % of the measuring distance.

3.7 Substitution Antenna

The **substitution antenna** is used to replace the equipment under test. For measurements below 1 GHz the **substitution antenna** shall be a half wavelength dipole resonant at the frequency under consideration, or a shortened dipole, calibrated to the half wavelength dipole. For measurements between 1 and 4 GHz either a half wavelength dipole or a horn radiator may be used. For measurements above 4 GHz a horn radiator shall be used. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an outside antenna is connected to the cabinet.

The distance between the lower extremity of the dipole and the ground shall be at least 30 cm.

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

3.8 Test Fixture

3.8.1 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:

1. A connection to an external power supply.

2. 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 be approved by the testing authority and shall conform to the following basic parameters:

a) The coupling loss shall not be greater than 30 dB.

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

c) Circuitry associated with the RF coupling shall contain no active or non linear devices.

d) The VSWR at the 50 Ω socket shall not be greater than 1.5 over the frequency range of the measurements.

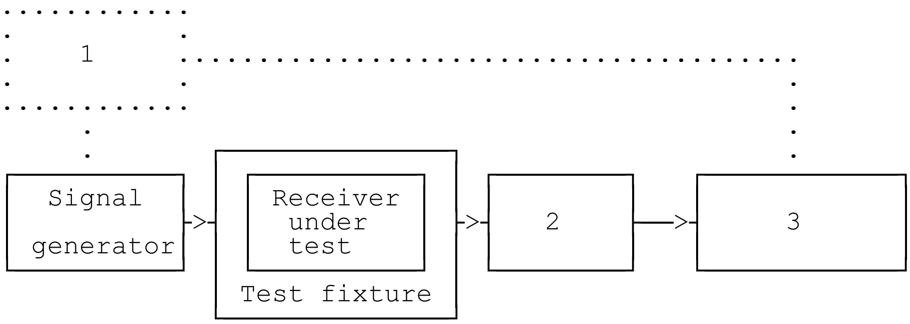
e) The coupling loss shall be independent of the position of the **test fixture** and be unaffected by the proximity of surrounding objects or people. The coupling loss shall be reproducible when the equipment under test is removed and replaced.

f) The coupling loss shall remain substantially constant when the environmental conditions are varied.The characteristics and calibration shall be included in the test report.

3.8.2 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 polarisation of the reference field.



1: - Bit stream: Bit stream generator.
- Message: Message generator.

2: - Analogue speech: AF load/acoustic coupler.
- Bit stream and message: Termination.

3: - Analogue speech: Distortion factor/audio level meter and psophometric filter.
- Bit stream: Bit error measuring test set.
- Message: Response measuring test set.

Figure 8: Calibration of the test fixture

3.8.2.1 Measuring Arrangement for calibration

a) Using the relevant method described in 5.3.1, measure the sensitivity expressed as field strength, and note the value of this field strength in dBµV/m and the polarisation 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, according to the method chosen in step a):

- a SINAD of 20 dB, or

- the opening of the squelch, or

- a bit error ratio of 10^{-2}, or

- a message acceptance ratio of 80 %

shall be noted.

c) The calibration of the **test fixture** is thus the linear relationship between the field strength in dBµV/m and the signal generator level in dBµV emf.

3.8.3 Mode of use

The **test fixture** may be used to enable some of the conducted measurements in Clause 4 to be carried out on equipment with an integral antenna.

It is used in the radiated carrier power and measured usable sensitivity expressed as a field strength measurements in Clause 5 to enable a measurement to be made under *extreme test conditions* or on equipment using a squelch circuit.

For the transmitter measurements calibration is not required. The procedures of subclause 4.2 shall be applied replacing the antenna connector of the transmitter by the antenna connector of the **test fixture**.

For the receiver measurements calibration is necessary. The procedures of subclause 4.3 shall be applied replacing the antenna connector of the receiver by the antenna connector of the **test fixture**.

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.

4 Conducted Measurements

4.1 General

This Clause contains all measurements which can be made using a direct 50 Ω connection to the equipment under test.

Bit stream measurements shall be performed on the 'raw' bit stream thus by-passing error correcting coders or decoders unless it is impossible to disassociate one from the other. Message measurements shall include error correcting coders and decoders, if fitted.

For equipments not fitted with an antenna socket, some measurements can be made using a temporary 50 Ω connector. Details and implications of such a procedure should be stated in the corresponding ETS.

When such a temporary connection is not available, the manufacturer shall provide a suitable **test fixture**. This provides a radio frequency coupling between a 50 Ω socket and the integral antenna, which allows some of the conducted measurements to be performed, but only for relative measurements and in a narrow frequency band. For receiver measurements, the **test fixture** must be calibrated at the frequency of the measurement. This approach shall not be used for the measurements referred to in the following subclauses:

- 4.2.2 (Tx) Carrier power
- 4.2.4 (Tx) Conducted spurious emissions
- 4.2.5 (Tx) Intermodulation attenuation
- 4.3.1 (Rx) Measured usable sensitivity
- 4.3.4 (Rx) Spurious response immunity
- 4.3.7 (Rx) Conducted spurious components
- 4.3.12 (Rx) Multipath sensitivity
- 4.4 Duplex operation

4.2 Transmitter

When conducting transmitter tests on equipment designed for intermittent operation, the specified maximum transmit time shall not be exceeded.

4.2.1 Frequency error

4.2.1.1 Definition

The frequency error of the transmitter is the difference between the unmodulated carrier frequency and the *nominal frequency* selected for the test.

4.2.1.2 Method of measurement

Figure 9: Measurement arrangement

a) The transmitter shall be connected to the *test load.* The carrier frequency shall be measured in the absence of modulation.

b) The measurement shall be repeated under *extreme test conditions.*

4.2.2 Carrier power

4.2.2.1 Definition

The carrier power is the average power delivered to the *test load* during one radio frequency cycle in the absence of modulation.

4.2.2.2 Method of measurement

Figure 10: Measurement arrangement

a) The transmitter shall be connected to the *test load* and the carrier or mean power delivered to this *test load* measured.

b) The value measured shall be compared with the rated RF output power.

c) The measurement shall be repeated under *extreme test conditions.*

4.2.3 Adjacent channel power

4.2.3.1 Definition

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

It is specified either as the ratio expressed in decibels of the carrier power to the adjacent channel power or as an absolute value.

4.2.3.2 Method of measurement

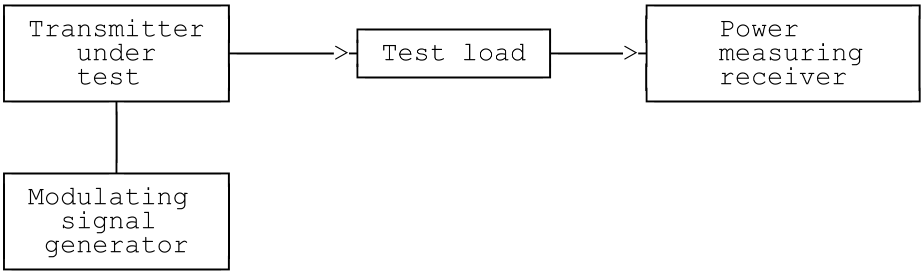


Figure 11: Measurement arrangement

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

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

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

Table 3: Frequency displacement

Channel separation (kHz)	Displacement (kHz)
12.5	8.25
20	13
25	17

The same result may be obtained by tuning the **power measuring receiver** (point D0 in the drawing of the power measuring filter shape) to the *nominal frequency* of the adjacent channel, if it has been suitably calibrated.

d) The transmitter shall be modulated as follows:

1 - Equipment for analogue speech shall be modulated with a 1250 Hz tone at a level which is 20 dB higher than that required to produce *normal deviation*.

2 - Equipment for data bits shall be modulated with the *test modulation D-M2* at the agreed deviation.

3 - Equipment for messages shall be modulated with the *test modulation D-M3* repeated continuously at the agreed deviation.

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

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

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

4.2.4 Conducted spurious emissions

4.2.4.1 Definition

Conducted spurious emissions are discrete signals whose power is conveyed by conduction to the *test load* at frequencies other than those of the carrier and sidebands resulting from the normal process of modulation.

They are specified as the power level of any discrete signal delivered into a *test load.*

4.2.4.2 Method of measurement

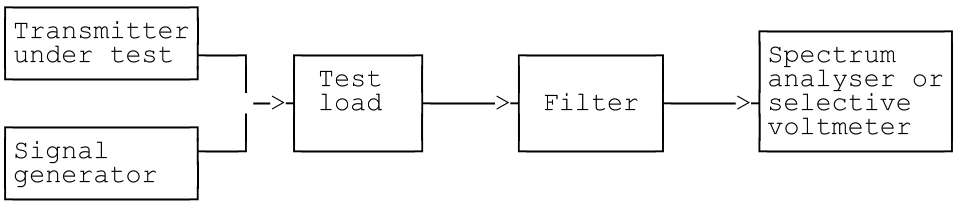


Figure 12: Measurement arrangement

a) The transmitter shall be connected to a spectrum analyser or a selective voltmeter through a *test load* and an appropriate filter to avoid overloading of the spectrum analyzer or selective voltmeter. The bandwidth of the spectrum analyser or selective voltmeter shall be between 10 and 100 kHz. The equipment used shall have sufficient dynamic range and sensitivity to achieve the required measurement accuracy at the specified limit.

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

For the measurement of spurious emissions at and above the second harmonic of the carrier frequency the filter used shall be a high pass filter with a stop band rejection exceeding 40 dB. The cut-off frequency of the high pass filter shall be approximately 1.5 times the transmitter carrier frequency.

Precautions may be required to ensure that the *test load* does not generate or that the high pass filter does not attenuate, the harmonics of the carrier.

b) The transmitter shall be unmodulated and operating at the maximum limit of its specified power range.

c) The frequency of the spectrum analyser or selective voltmeter shall be adjusted over the specified frequency range. The frequency and level of every spurious emission found shall be noted. The emissions within the channel occupied by the transmitter carrier and its adjacent channels shall not be recorded.

d) If the spectrum analyser or selective voltmeter has not been calibrated in terms of power level at the transmitter output, the level of any detected components shall be determined by replacing the transmitter by the signal generator and adjusting it to reproduce the frequency and level of every spurious emission recorded in step c).

e) The absolute power level of each of the emissions noted shall be measured and recorded.

f) The measurement shall be repeated with the transmitter in stand-by condition if this option is available.

4.2.5 Intermodulation attenuation

4.2.5.1 Definition

For the purpose of this test the intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the carrier and an interfering signal entering the transmitter via its antenna.

It is specified as the ratio, in decibels, of the power level of the third order intermodulation product to the carrier power level.

4.2.5.2 Method of measurement

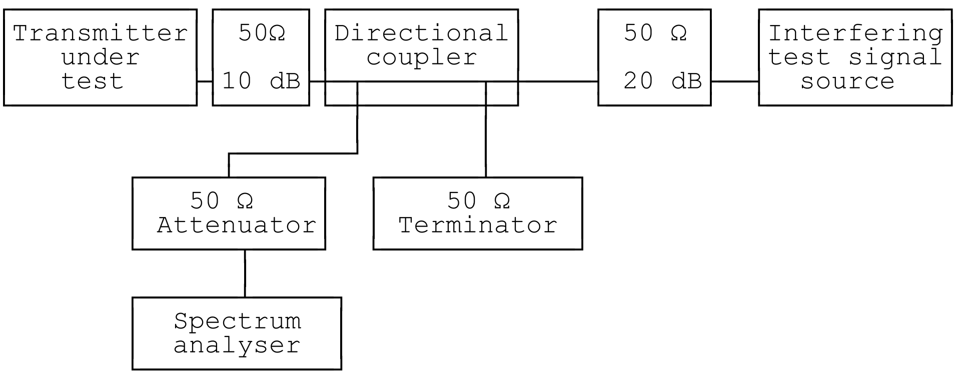


Figure 13: Measurement arrangement

a) Preliminary to the measurement the carrier power of the transmitter under test shall be measured according to subclause 4.2.2, under normal conditions only, and the value recorded.

The transmitter shall be connected to a 50 Ω 10 dB power attenuator load and via a directional coupler to a spectrum analyser. An attenuator may be required to avoid overloading the spectrum analyser.

The length of the cable between the transmitter under test and the 10 dB power attenuator shall be kept to a minimum.

The directional coupler shall have an insertion loss of less than 1 dB, a sufficient bandwidth, and a directivity of more than 20 dB.

The test signal source may be a signal generator and a power amplifier or another transmitter, the output power of which is adjustable.

The transmitter under test and the test signal source shall be physically separated in such a way that the measurement is not influenced by direct radiation.

b) Replace the transmitter under test in the measurement arrangement above by a RF power meter.

c) The test signal source shall be unmodulated and the frequency shall be within 50 to 100 kHz above the frequency of the transmitter under test.

The frequency shall be chosen in such a way that the intermodulation components to be measured do not coincide with other spurious emissions.

d) The test signal power level shall be adjusted to -30 dB, relative to the carrier power level recorded above, measured on the RF power meter.

e) The transmitter under test shall be reconnected to the 10 dB power attenuator, as shown above.

f) The transmitter shall be unmodulated and the spectrum analyser adjusted to give a maximum indication with a frequency scan width of 500 kHz.

g) The intermodulation components shall be measured by direct observation on the spectrum analyser and the ratio of the largest third order intermodulation component to the carrier recorded which is situated at the same frequency offset (within 50 to 100 kHz) selected in step c, below the transmitter frequency.

h) This measurement shall be repeated with the test signal at a frequency within 50 to 100 kHz below the transmitter frequency. In this case the largest third order intermodulation component to be observed in step g is situated at the same frequency offset selected in step c, above the transmitter frequency.

4.2.6 Attack time

4.2.6.1 Definition

The transmitter attack time is the time interval between the instant at which the final irrevocable logic decision to power up the transmitter is taken and the moment after which:

a) the unmodulated transmitter power always remains within a level -1 dB and +1.5 dB of the steady state carrier power, or

b) the frequency of the carrier always remains within ±1 kHz from its steady state frequency.

NOTE: This may be used for checking the channel efficiency of systems and for defining the timings in protocols.

4.2.6.2 Method of measurement

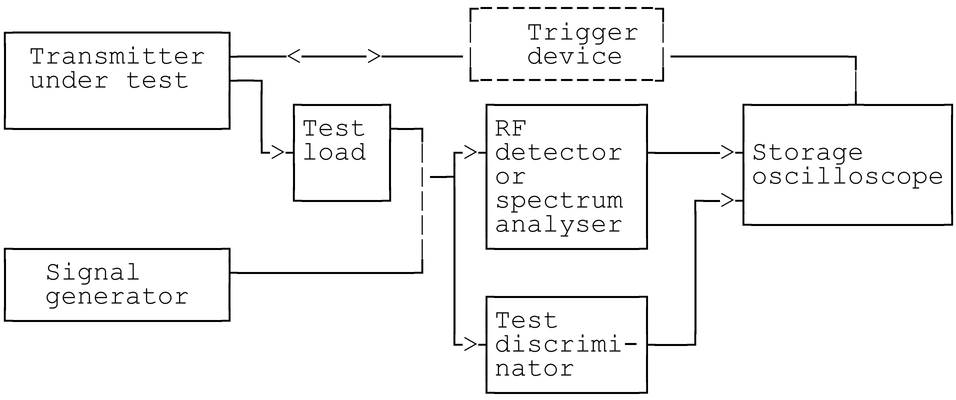


Figure 14: Measurement arrangement

a) The transmitter is connected to a RF detector and to a **test discriminator** via a matched *test load*. The attenuation of the *test load* shall be chosen in such a way that the input of the **test discriminator** is protected against overload and the limiter amplifier of the **test discriminator** operates correctly in the limiting range as soon as the transmitter carrier power (before attenuation) exceeds 1 mW. A dual trace storage oscilloscope (or a transient recorder) records the amplitude transient from the detector on a logarithmic scale and the frequency transient from the discriminator. A *trigger device* may be required to ensure that the start of the sweep of the oscilloscope timebase occurs the instant at which the final irrevocable logic decision to power up the transmitter is taken.

b) The traces of the oscilloscope shall be calibrated in power and frequency (Y axes) and in time (X axis), using the signal generator.

c) The transmitter attack time shall be measured by direct reading on the oscilloscope.

4.2.7 Release time

4.2.7.1 Definition

The transmitter release time is the time interval between the instant at which the final irrevocable logic decision to power down the transmitter is taken and the moment when the unmodulated transmitter power has decayed to a level 50 dB below the *rated RF output power*.

NOTE: This may be used for checking the channel efficiency of systems and for defining the timings in protocols.

4.2.7.2 Method of measurement

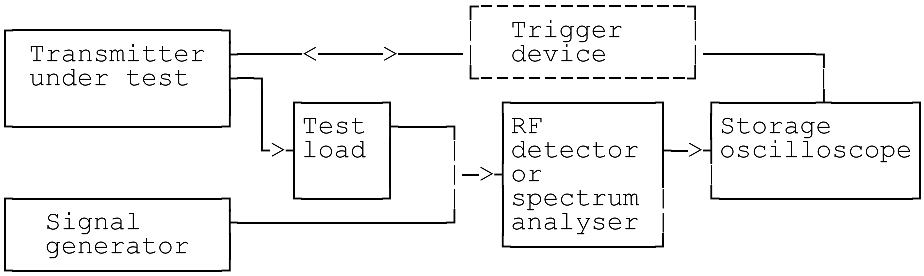


Figure 15: Measurement arrangement

a) The transmitter is connected to a RF detector via a matched *test load*. A storage oscilloscope (or a transient recorder) records the amplitude transients from the detector on a logarithmic scale (dynamic range ≥ 50 dB).

A *trigger device* may be required to start the sweep of the oscilloscope the instant at which the final irrevocable decision to power down the transmitter is taken.

If the transmitter possesses an automatic powering down facility (e.g. in the case of fixed length messages transmission), it will replace the *trigger device* for starting the sweep of the oscilloscope.

b) The traces of the oscilloscope shall be calibrated in power (Y axis) and in time (X axis) by replacing the transmitter and test load by the signal generator.

c) The transmitter release time shall be measured by direct reading on the oscilloscope.

4.2.8 Transient adjacent channel power

4.2.8.1 Definition

The transient adjacent channel power of a transmitter is expressed as the ratio in decibels of the peak power in the adjacent channels, during the rise or decay time, to the unmodulated carrier power.

4.2.8.2 Method of measurement

This method of measurement uses a **power measuring receiver** in the adjacent channels. It must be preceded by two preliminary verifications, in order to guarantee that the transients will not appear outside either of the channels adjacent to the carrier and therefore the measurement shall be made in the first adjacent channels next to the carrier only.

4.2.8.2.1 Preliminary verification N°1

This verification has to be made when the transmitter is turned on and off. It uses in both cases the measuring arrangement described for the transmitter "attack time". While the carrier power is greater than 1 mW the instantaneous frequency of the carrier must remain within the tolerance of ±δf1, where δf1 is the channel separation.

4.2.8.2.2 Preliminary verification N°2

This verification uses the measuring arrangement described for the transmitter "attack time" and transmitter "release time". The rise and decay time measured as the time elapsed between the -30 dB and the -6 dB relative to the steady state carrier power must be greater than 0.2 ms. In addition the shape of the slopes during the rise and decay time shall not exhibit abrupt changes in level or parasitic oscillation.

4.2.8.2.3 Measurement

For application of this method it should be noted that, at the present date (January 1991) no power measurement receivers are available on the market giving sufficient accuracy in the case of short transmission times.

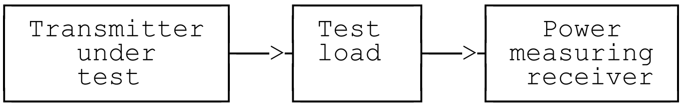


Figure 16: Measurement arrangement

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

b) 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 receiver attenuator setting and the reading of the meter shall be recorded and the transmitter switched off.

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 the following table.

Table 4: Frequency displacement

Channel separation (kHz)	Displacement (kHz)
12.5	8.25
20	13
25	17

The same result may be obtained by tuning the **power measuring receiver** (point D0 in the drawing of the power measuring filter shape) to the nominal frequency of the adjacent channel, if it has been suitably calibrated.

d) The transmitter shall be switched on and off once. The receiver variable attenuator shall be adjusted to obtain, with the peak transient power, the same level as in step b) or a known relation to it. This value shall be recorded.

e) The ratio of adjacent channel peak power to carrier power is the difference between the attenuator settings in steps b) and d), corrected for any differences in the reading of the meter.

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

4.2.9 Frequency deviation

4.2.9.1 Definition

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

4.2.9.2 Method of measurement

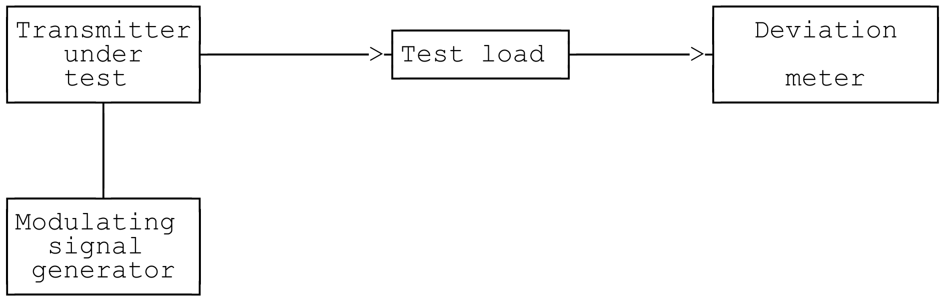


Figure 17: Measurement arrangement

The transmitter shall be connected to the *test 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. The deviation meter bandwidth must be suitable to accommodate the highest modulating frequency and to achieve the required dynamic range.

4.2.9.2.1 Analogue signals within the audio bandwidth

a) The modulation frequency shall be varied between 300 Hz and the *upper specified audio frequency limit.* The level of this test signal shall be 20 dB above the level corresponding to a deviation at 1000 Hz of 12 % of the channel separation.

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

4.2.9.2.2 Analogue signals above the audio bandwidth

a) The modulation frequency shall be varied between the *upper specified audio frequency limit* and a frequency equal to the channel separation for which the equipment is intended. The level of this signal shall correspond to a deviation at 1000 Hz of 12 % of the channel separation.

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

4.2.9.2.3 Digital signals

For indirect modulation where the digital signal may either phase or frequency modulate an audio frequency sub-carrier which then modulates the radio frequency carrier the following method shall be used.

a) The transmitter shall be modulated with the *test modulation D-M0* at the *normal deviation* level.

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

c) The transmitter shall be modulated with the *test modulation D-M1* at the *normal deviation* level.

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

NOTE: Other types of digital modulation will require an alternative method.

4.2.10 Limiter characteristic for analogue speech

4.2.10.1 Definition

The limiter characteristic expresses the capability of the transmitter to be modulated with a frequency deviation approaching the *maximum permissible frequency deviation.*

4.2.10.2 Method of measurement

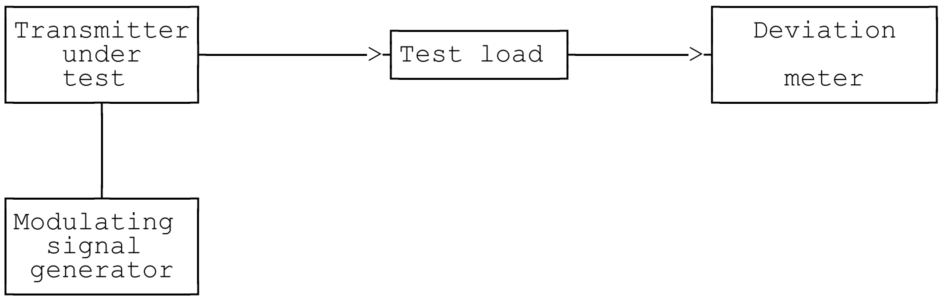


Figure 18: Measurement arrangement

a) The transmitter under test shall be connected via the *test load* to the deviation meter.

b) A modulating signal at a frequency of 1000 Hz shall be applied to the transmitter. The level shall be adjusted to produce a frequency deviation of 20 % of the *maximum permissible frequency deviation.*

c) The level shall be raised 20 dB and the deviation recorded.

d) The measurement shall be repeated under *extreme test conditions.*

4.2.11 Acoustic sensitivity of modulator for analogue speech

4.2.11.1 Definition

The acoustic sensitivity of the modulator is the capability of the transmitter to be modulated satisfactorily when an audio frequency signal corresponding to the normal average speech level is applied to the microphone.

4.2.11.2 Method of measurement

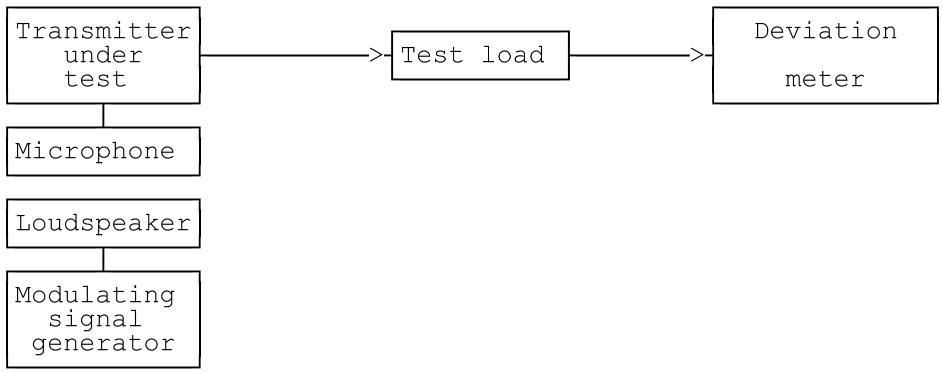


Figure 19: Measurement arrangement

The use of an anechoic acoustic chamber is recommended.

Great care must be taken with the acoustic interface to ensure that background noise is minimised and that the correct loudness level is applied to the microphone.

a) The transmitter under test shall be connected via the *test load* to the deviation meter.

b) An audio frequency signal of 1000 Hz shall be applied to the microphone. The level shall be adjusted to produce a frequency deviation of 20 % of the maximum permissible frequency deviation.

c) The loudness level at the diaphragm of the microphone shall be recorded.

4.2.12 Audio frequency response for analogue speech

4.2.12.1 Definition

The audio frequency response is the variation of the transmitter frequency deviation as a function of the modulating frequency.

4.2.12.2 Method of measurement

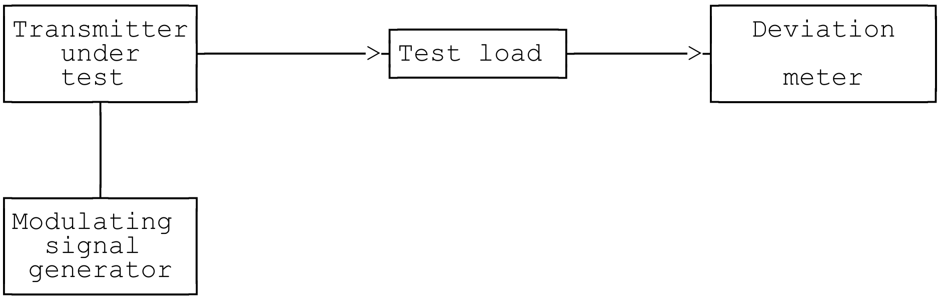


Figure 20: Measurement arrangement

a) The transmitter under test shall be connected via the *test load* to the deviation meter.

b) A modulating signal with a frequency of 1000 Hz shall be applied to the transmitter. The level shall be adjusted to produce a frequency deviation of 20 % of the maximum permissible frequency deviation.

c) The modulating frequency shall be varied between 300 Hz and its upper audio frequency limit. The level of the modulating signal shall remain constant.

d) The variation of the deviation shall be recorded at suitable intervals of input frequency.

4.2.13 Harmonic distortion for analogue speech

4.2.13.1 Definition

The harmonic distortion of a transmitter when modulated with an audio frequency signal is defined as the ratio, expressed as a percentage, of the rms voltage of all the harmonic components of the fundamental audio frequency to the total rms voltage of the signal after linear demodulation.

4.2.13.2 Method of measurement

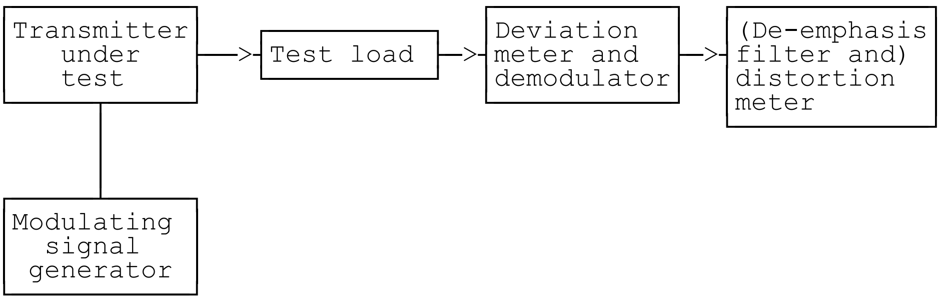


Figure 21: Measurement arrangement

a) The transmitter under test shall be connected via the *test load* to the deviation meter which has a linear audio output. The output of the deviation meter demodulator shall be connected to the distortion meter through a 6 dB/octave de-emphasis filter when the transmitter is phase modulated. If the transmitter is frequency modulated then no filter is required.

b) For phase modulation the transmitter shall be modulated successively at frequencies of 300 Hz, 500 Hz and 1000 Hz maintaining a constant modulation index (i.e. keeping the ratio of frequency deviation to the modulating frequency constant). This is the index which produces 60 % of the *maximum permissible frequency deviation* when modulated at 1000 Hz.

For frequency modulation the transmitter shall be modulated successively at frequencies of 300 Hz, 500 Hz and 1000 Hz with a frequency deviation equal to 60 % of the *maximum permissible frequency deviation.*

c) The harmonic distortion shall be recorded at each of the frequencies.

d) The measurement shall be repeated under *extreme test conditions* with the modulating signal at 1000 Hz and the frequency deviation equal to 70 % of the *maximum permissible frequency deviation*.

4.2.14 Residual modulation for analogue speech

4.2.14.1 Definition

The residual modulation of a transmitter is the ratio, expressed in decibels, of the audio frequency output power produced after the demodulation of the radio frequency signal in the absence of wanted modulation to the audio frequency output power produced by the application of specified *test modulation*.

4.2.14.2 Method of measurement

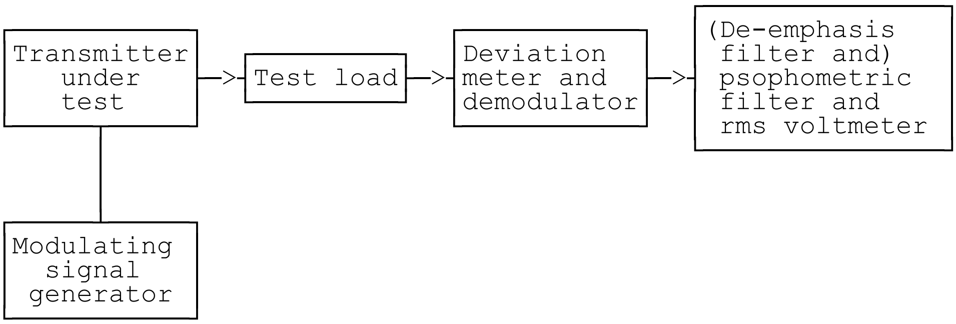


Figure 22: Measurement arrangement

Care must be taken to avoid false results caused by the emphasis of low frequency noise in the demodulator.

a) The transmitter under test shall be connected via the *test load* to the deviation meter which has a linear audio output. The output of the deviation meter demodulator shall be connected to the rms voltmeter through a 6 dB/octave de-emphasis filter and via the *psophometric weighting network* when the transmitter is phase modulated. If the transmitter is frequency modulated then the de-emphasis filter is not required.

b) *Test modulation A-M1* shall be applied to the transmitter and the level on the rms voltmeter recorded.

c) The modulation shall be removed and the new level recorded.

d) The residual modulation is the ratio, expressed in dB, of the value recorded in step c) to the value recorded in step b).

4.3 Receiver

For all measurements which are applicable to equipments capable of reception of analogue speech, a *psophometric weighting network* followed by the SINAD meter (or a distortion factor meter incorporating a *1000 Hz band-stop filter*) shall be connected to the receiver output terminals via an *audio frequency load* or by an **acoustic coupler** for receivers not fitted with a direct connection. In the latter case, the acoustic equivalent of the SINAD ratio of 20 or 14 dB is measured.

For all receiver measurements for analogue speech, unless otherwise stated, the receiver volume control where possible, 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.* This control shall not be readjusted between *normal and extreme test conditions*.

For all measurements which are applicable to equipments, capable of reception of bit streams, a bit error measuring test set shall be connected to the receiver via a suitable *audio frequency termination*. For bit stream measurements the bit pattern of the modulating signal shall be compared to the bit pattern obtained from the receiver after demodulation, during at least 2500 bits or 5 sequences of D-M2 modulation when it is used.

However for the purpose of identifying some physical phenomena shorter sequences can be used.

For all measurements which are applicable to equipments, capable of reception of messages, a response measuring test set shall be connected to the receiver output terminals via a suitable *audio frequency termination*.

4.3.1 Measured usable sensitivity

4.3.1.1 Measured usable sensitivity for analogue speech

4.3.1.1.1 Definition

The measured usable sensitivity for analogue speech of the receiver is the minimum level of signal, expressed as an emf, at the *nominal frequency* of the receiver and with specified test modulation which produces through a *psophometric weighting network* a SINAD ratio of 20 dB.

4.3.1.1.2 Method of measurement

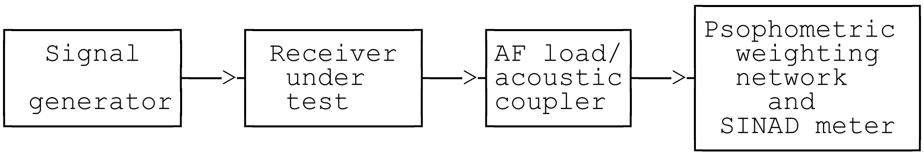


Figure 23: Measurement arrangement

a) A signal generator shall be connected to the receiver input. The signal generator shall be at the *nominal frequency* of the receiver and shall have test modulation A-M1.

b) The amplitude of the signal generator shall be adjusted until a SINAD ratio of 20 dB is obtained.

c) The test signal input level under these conditions is the value of the measured usable sensitivity for analogue speech. This level shall be recorded.

d) The measurement shall be repeated under *extreme test conditions.*

4.3.1.2 Measured usable sensitivity for bit stream

4.3.1.2.1 Definition

The measured usable sensitivity for bit stream of the receiver is the minimum level of signal expressed as an emf, at the *nominal frequency* of the receiver modulated with specified test signal which produces, after demodulation, a data signal with a bit error ratio of 10^{-2}.

4.3.1.2.2 Method of measurement

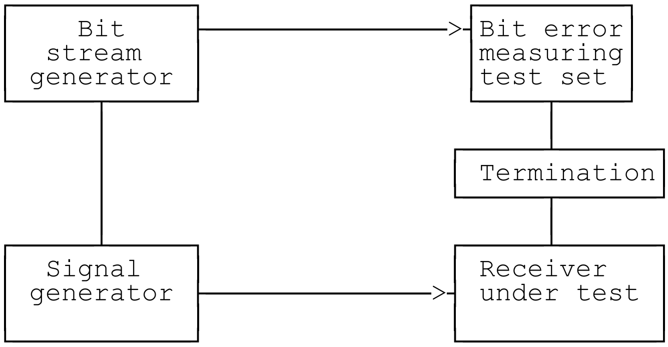


Figure 24: Measurement arrangement

a) A signal generator shall be connected to the receiver input. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by the *test modulation D-M2*.

b) The amplitude of the signal generator shall be adjusted until the bit error ratio of 10^{-2} is obtained.

c) The measured usable sensitivity for bit stream shall be recorded as the emf of the input signal to the receiver.

d) The measurement shall be repeated under *extreme test conditions.*

4.3.1.3 Measured usable sensitivity for messages

4.3.1.3.1 Definition

The measured usable sensitivity for messages of the receiver is the minimum level of signal, expressed as an emf, at the *nominal frequency* of the receiver modulated by a test signal which produces, after demodulation, a message acceptance ratio of 80 %.

4.3.1.3.2 Method of measurement

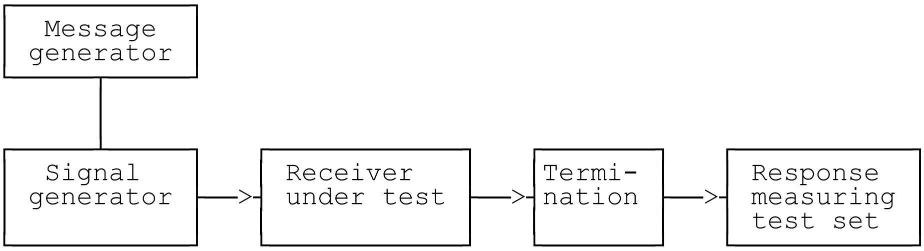


Figure 25: Measurement arrangement

a) A signal generator shall be connected to the receiver input. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by the *test modulation D-M3.*

b) The amplitude of the signal generator shall be adjusted that a successful message response ratio of less than 10 % is obtained.

c) 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 recorded.

d) 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 have been recorded.

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

f) The measurement shall be repeated under *extreme test conditions.*

4.3.2 Co-channel rejection

4.3.2.1 Co-channel rejection for analogue speech

4.3.2.1.1 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 decibels 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.

4.3.2.1.2 Method of measurement

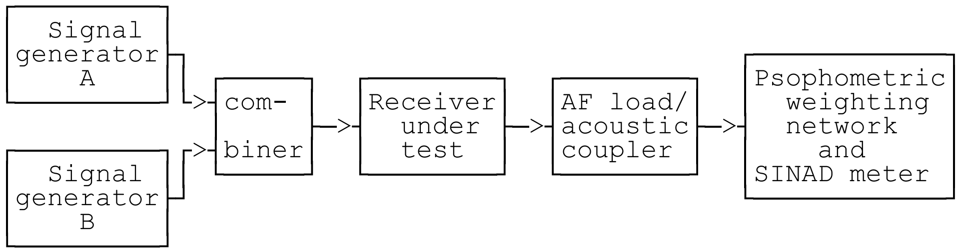


Figure 26: Measurement arrangement

a) 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 A-M1*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3*. Both input signals shall be at the *nominal frequency* of the receiver under test.

b) Initially the unwanted signal shall be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input. The unwanted signal shall then be switched on and its level shall be adjusted until the SINAD ratio through a *psophometric weighting network* is reduced to 14 dB.

c) The co-channel rejection 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 for which the specified reduction in SINAD occurs.

4.3.2.2 Co-channel rejection for bit stream

4.3.2.2.1 Definition

The co-channel rejection for bit stream 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 decibels of the level of the unwanted signal recorded in step (d) to the specified *wanted signal level* at the receiver input, for which the bit error ratio is 10^{-2}.

4.3.2.2.2 Method of measurement

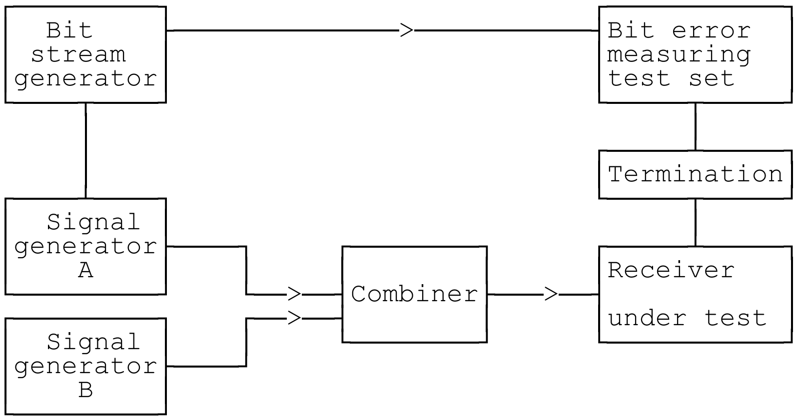


Figure 27: Measurement arrangement

a) 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-M2.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3*. Both input signals shall be at the *nominal frequency* of the receiver under test.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The unwanted signal shall then be switched on, and its input level adjusted until a bit error ratio of about 10^{-1} is obtained.

d) The wanted signal shall then be transmitted whilst observing the bit error ratio. The level of the unwanted signal shall be reduced in steps of 1 dB until a bit error ratio of 10^{-2} or better is obtained. The level of the unwanted signal shall then be recorded.

e) The co-channel rejection ratio for bit stream shall be recorded as the ratio in dB of the levels of the unwanted signal recorded in step d) to the level of the wanted signal, at the receiver input.

4.3.2.3 Co-channel rejection for messages

4.3.2.3.1 Definition

The co-channel rejection for messages is a measure of the capability of the receiver to receive a wanted signal at the *nominal frequency* modulated by a test signal 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 decibels 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 %.

4.3.2.3.2 Method of measurement

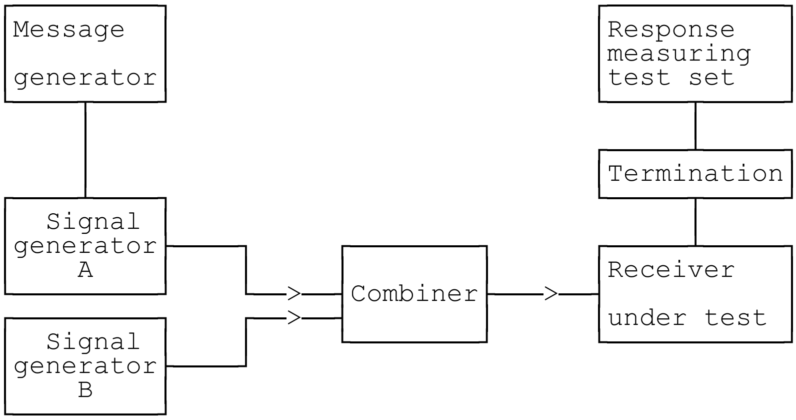


Figure 28: Measurement arrangement

a) Two signal generators, A and B shall be connected to the receiver 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.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3*. Both input signals shall be at the *nominal frequency* of the receiver under test.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) 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 recorded.

e) 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 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 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.

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

4.3.3 Adjacent channel selectivity

4.3.3.1 Adjacent channel selectivity for analogue speech

4.3.3.3.1 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 decibels 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 decibels.

4.3.3.1.2 Method of measurement

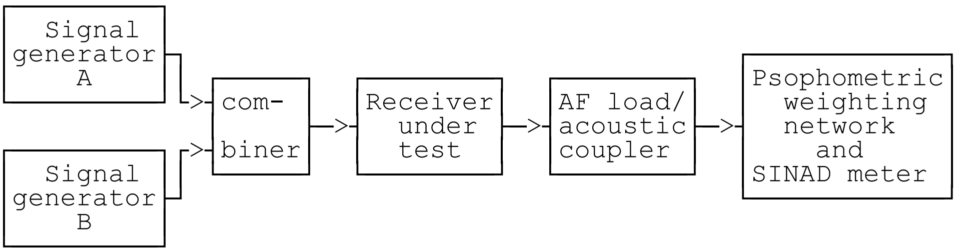


Figure 29: Measurement arrangement

a) 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 A-M1*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be at the frequency of the channel immediately above that of the wanted signal.

b) Initially the unwanted signal shall be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input. The unwanted signal shall then be switched on and its level shall be adjusted until the SINAD ratio through a *psophometric weighting network* is reduced to 14 dB. This level shall be recorded.

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

d) The adjacent channel selectivity for analogue speech shall be recorded for the upper and lower adjacent channels as the ratio in dB of the level of the unwanted signal to the level of the wanted signal.

e) The measurements shall be repeated under *extreme test conditions* using the relevant value of the *wanted signal level.*

4.3.3.2 Adjacent channel selectivity for bit stream

4.3.3.2.1 Definition

The adjacent channel selectivity for bit stream 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 decibels 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 bit error ratio is 10^{-2}.

4.3.3.2.2 Method of measurement

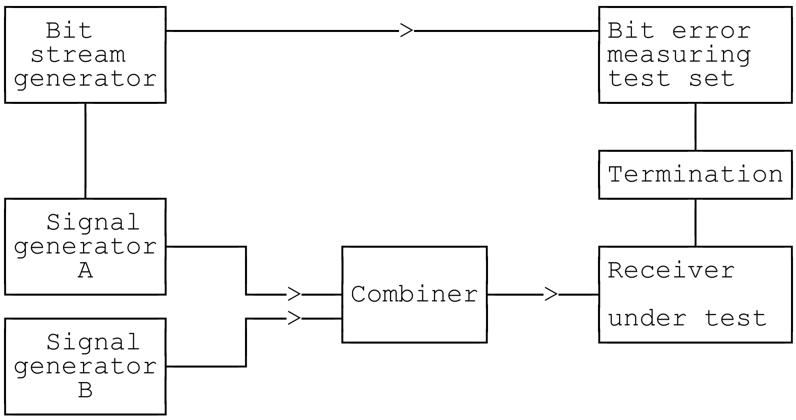


Figure 30: Measurement arrangement

a) 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-M2*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to the frequency of the channel immediately above that a wanted signal.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The unwanted signal shall then be switched on, and the input level adjusted until a bit error ratio of about 10^{-1} is obtained.

d) The wanted signal shall then be transmitted whilst observing the bit error ratio. The level of the unwanted signal shall be reduced in steps of 1 dB until a bit error ratio of 10^{-2} or better is obtained. The level of the unwanted signal shall then be recorded.

e) The adjacent channel selectivity for bit stream 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.

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

g) The measurement shall be repeated under *extreme test conditions* using the relevant value of the *wanted signal level*.

4.3.3.3 Adjacent channel selectivity for messages

4.3.3.3.1 Definition

The adjacent channel selectivity for messages is a measure of the capability of the receiver to receive a wanted signal at the *nominal frequency* modulated by a test signal 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 decibels 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 ratio is 80 %.

4.3.3.3.2 Method of measurement

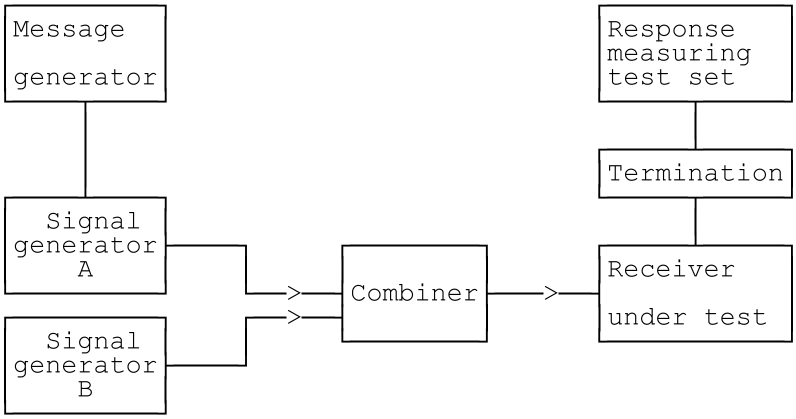


Figure 31: Measurement arrangement

a) Two signal generators, A and B shall be connected to the receiver 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.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to the frequency of the channel immediately above that of the wanted signal.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) 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 recorded.

e) 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 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 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.

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

g) 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 recorded in steps d) and e) to the level of the wanted input signal.

h) The measurement shall be repeated under *extreme test conditions* using the relevant value of the *wanted signal level*.

4.3.4 Spurious response immunity

The particular method to be used when performing the calculation of the limited frequency range and the actual spurious frequencies shall be included in the appropriate ETS.

4.3.4.1 Spurious response immunity for analogue speech

4.3.4.1.1 Definition

The spurious response immunity for analogue speech is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the *nominal frequency* and an unwanted signal at any other frequency at which a response is obtained.

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

4.3.4.1.2 Method of measurement

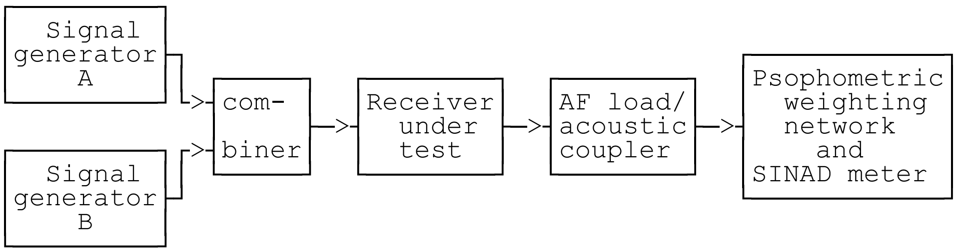


Figure 32: Measurement arrangement

a) 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 A-M1*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3*.

b) Initially the unwanted signal shall be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input. The unwanted signal shall then be switched on and its level shall be adjusted to level which is 80 db in excess of the *wanted signal level*, when measured at the receiver input. The frequency of the unwanted signal shall then be varied over the specified *limited frequency range* plus 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.

c) At any frequency at which a response is obtained, the unwanted signal level shall be adjusted until the SINAD ratio through a *psophometric weighting network* is reduced to 14 dB.

d) The spurious response immunity ratio for analogue speech shall be recorded for the frequency concerned as the ratio in dB between the unwanted signal and the wanted signal at the receiver input.

4.3.4.2 Spurious response immunity for bit stream

4.3.4.2.1 Definition

The spurious response immunity for bit stream is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the *nominal frequency* and an unwanted signal at any other frequency at which a response is obtained.

It is specified as the ratio in decibels of the level of the unwanted signal to a specified level of the wanted signal at the receiver input for which the bit error ratio is 10^{-2}.

4.3.4.2.2 Method of measurement

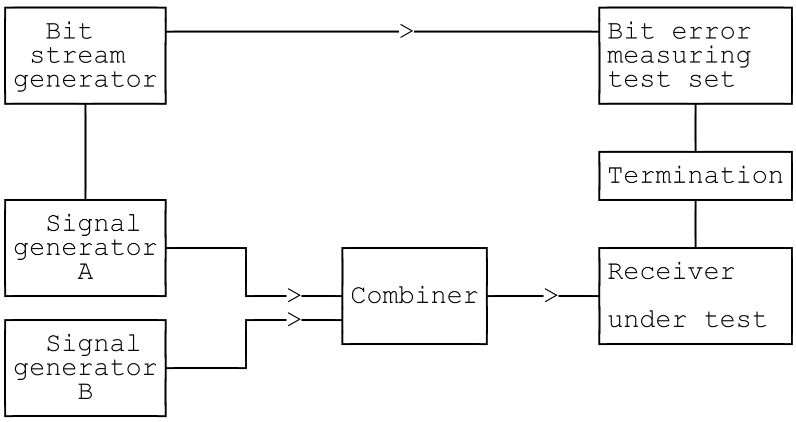


Figure 33: Measurement arrangement

a) 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-M2*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The unwanted signal shall then be switched on, and the input level adjusted until a bit error ratio of about 10^{-1} is obtained.

d) The wanted signal shall then be transmitted whilst observing the bit error ratio. The level of the unwanted signal shall be reduced in steps of 1 dB until a bit error ratio of 10^{-2} or better is obtained. The level of the unwanted signal shall then be recorded.

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

f) The spurious response immunity for bit stream shall be recorded for the frequency concerned as the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input.

4.3.4.3 Spurious response immunity for messages

4.3.4.3.1 Definition

The spurious response immunity for messages is a measure of the capability of the receiver to discriminate between the wanted signal modulated by a test signal at the *nominal frequency* and an unwanted signal at any other frequency at which a response is obtained.

It is specified as the ratio in decibels 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 %.

4.3.4.3.2 Method of measurement

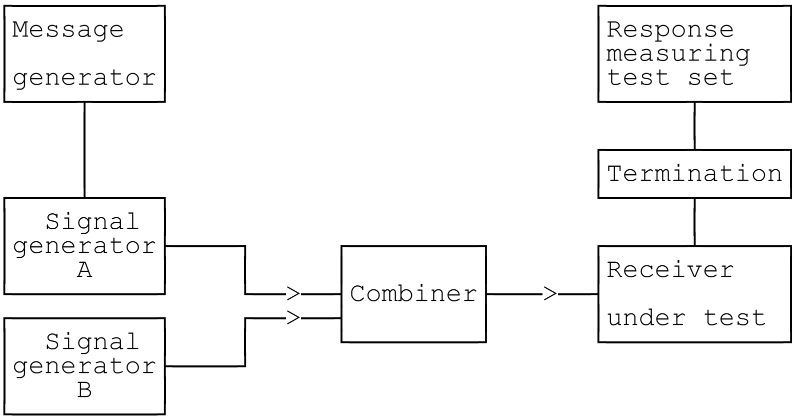


Figure 34: Measurement arrangement

a) Two signal generators, A and B shall be connected to the receiver 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.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) 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 recorded.

e) 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 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 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.

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

g) The spurious response immunity for messages shall be recorded for the frequency concerned as the ratio in dB of the average of the levels of the unwanted signal recorded in steps d) and e) to the level of the wanted signal at the receiver input.

4.3.5 Intermodulation immunity

4.3.5.1 Intermodulation immunity for analogue speech

4.3.5.1.1 Definition

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

For the purpose of this measurement it is specified as the ratio in decibels of the common level of two equal 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 decibels.

4.3.5.1.2 Method of measurement

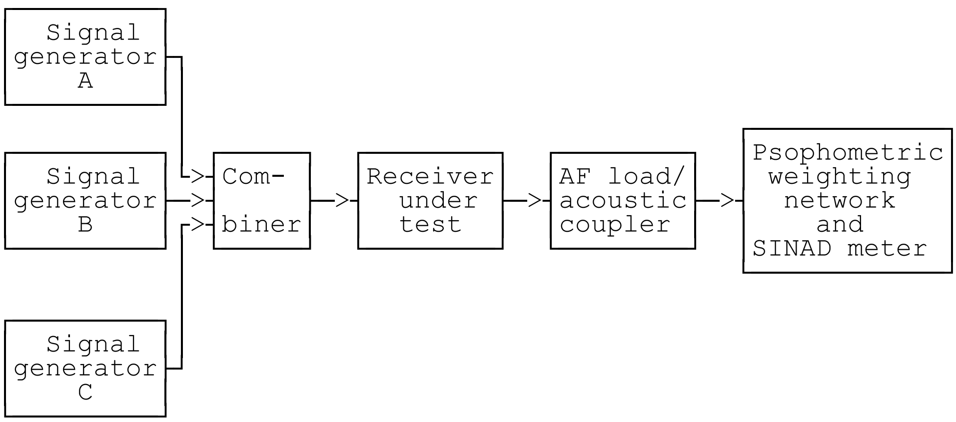


Figure 35: Measurement arrangement

a) Three signal generators, A, B and C shall be connected to the receiver 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 A-M1.* The unwanted signal, represented by signal generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the *nominal frequency* of the receiver. The second unwanted signal, represented by signal generator C, shall have *test modulation A-M3* and adjusted to a frequency 100 kHz above the *nominal frequency* of the receiver.

b) Initially the unwanted signals shall be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The two unwanted signals shall then be switched on. The amplitude of the two unwanted signals shall be maintained equal and shall be adjusted until the SINAD ratio, through a *psophometric weighting network* is reduced to 14 dB. The frequency of signal generator B shall be adjusted to produce the maximum degradation of the SINAD ratio. The level of the two unwanted test signals shall be readjusted to restore the SINAD ratio of 14 dB. This level shall be recorded.

d) The intermodulation immunity for analogue speech shall be recorded as the ratio in dB of the level of the unwanted signals recorded in step (c) to the level of the wanted signal.

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

4.3.5.2 Intermodulation immunity for bit stream

4.3.5.2.1 Definition

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

For the purpose of this measurement it is specified as the ratio in decibels of the common level of two equal unwanted signals to a specified level of the wanted signal at the receiver input for which the bit error ratio is 10^{-2}.

4.3.5.2.2 Method of measurement

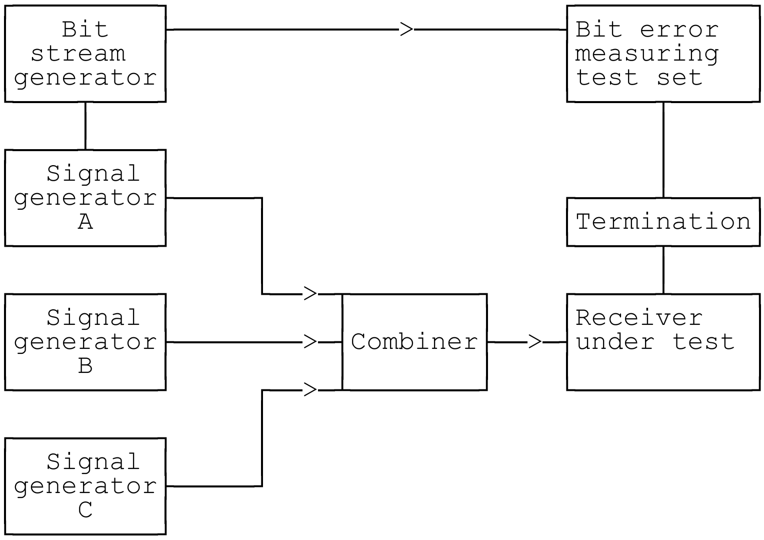


Figure 36: Measurement arrangement

a) Three signal generators, A, B and C shall be connected to the receiver 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-M2*. The unwanted signal, represented by signal generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the *nominal frequency* of the receiver. The second unwanted signal, represented by signal generator C, shall have *test modulation A-M3* and adjusted to a frequency 100 kHz above the *nominal frequency* of the receiver.

b) Initially signal generators B and C will be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) Signal generators B and C shall then be switched on. The output levels of the two signal generators shall be maintained equal and adjusted to a value such that a bit error ratio of about 10^{-1} is obtained.

d) The wanted signal shall then be transmitted whilst observing the bit error ratio. The level of the unwanted signals shall be reduced in steps of 1 dB until a bit error ratio of 10^{-2} or better is obtained. This level shall be recorded.

e) The intermodulation immunity for bit stream shall be recorded as the ratio in dB of the level of the unwanted signals recorded in step (d) to the level of the wanted signal.

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

4.3.5.3 Intermodulation immunity for messages

4.3.5.3.1 Definition

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

For the purpose of this measurement it is specified as the ratio in decibels of the common level of two equal unwanted signals to a specified level of the wanted signal at the receiver input, for which the message acceptance ratio is 80 %.

4.3.5.3.2 Method of measurement

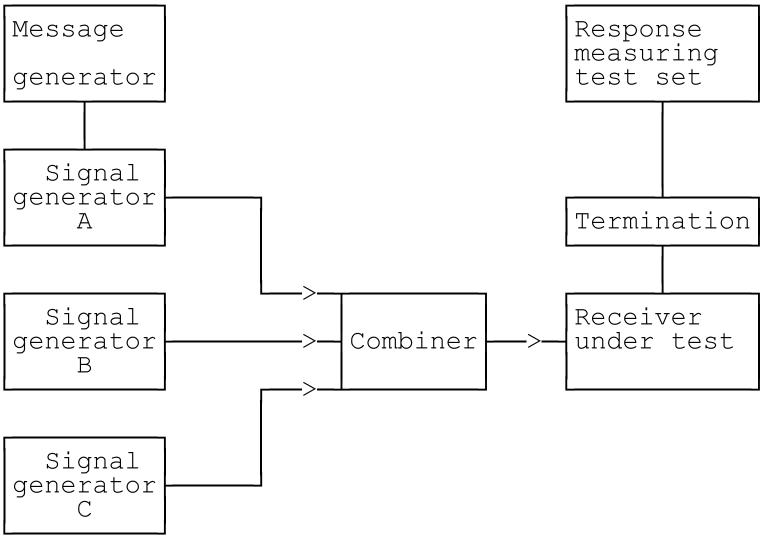


Figure 37: Measurement arrangement

a) Three signal generators, A, B and C shall be connected to the receiver 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*. The unwanted signal, represented by the signal generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the nominal frequency of the receiver. The second unwanted signal, represented by the signal generator C, shall have *test modulation A-M3* and shall be adjusted to a frequency 100 kHz above the nominal frequency.

b) Initially signal generators B and C will be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) 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 then 10 % is obtained.

d) 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 recorded.

e) 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 if a response is not obtained the level of the unwanted signals shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signals 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 signals shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

f) The intermodulation immunity for messages shall be recorded as the ratio in dB of the average of the levels of the unwanted signals recorded in steps d) and e) to the level of the wanted input signal.

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

4.3.6 Blocking immunity or desensitisation

4.3.6.1 Blocking immunity or desensitisation for analogue speech

4.3.6.1.1 Definition

Blocking immunity or desensitisation for analogue speech is a measure of the capability of the receiver to receive the wanted modulated signal at the *nominal frequency* without exceeding a given degradation due to the presence of an unwanted unmodulated high input signal.

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

4.3.6.1.2 Method of measurement

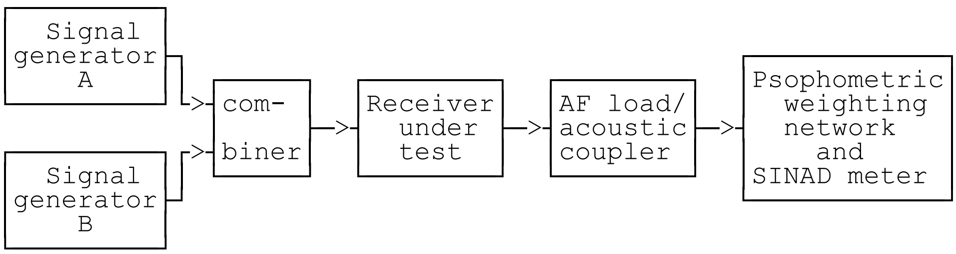


Figure 38: Measurement Arrangement

a) 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 A-M1*.

b) Initially the unwanted signal, represented by signal generator B, shall be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* when measured at the receiver input.

c) The unwanted signal shall be unmodulated. Its frequency shall be placed at least 1 MHz away of the carrier frequency and its level shall be increased until a reduction in the receiver output power or a reduction of the SINAD ratio at the receiver output is observed.

d) Maintaining this level constant the frequency of the unwanted signal shall be varied between +1 MHz and +10 MHz, also between -1 MHz and -10 MHz relative to the nominal *frequency* of the receiver. However for practical reasons the measurements shall be carried out at certain frequencies of the unwanted signal at approximately ±1 MHz, ±2 MHz, ±5 MHz and ±10 MHz relative to the nominal frequency of the receiver. The frequency at which the greatest degradation occurs shall be noted taking care to be sure that it is not a spurious response.

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

a) a reduction of 3 dB in the receiver audio output power, or

b) a reduction to 14 dB of the SINAD ratio at the receiver output,

whichever occurs first. This level shall be recorded.

f) The blocking ratio 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.

4.3.6.2 Blocking immunity for bit stream

4.3.6.2.1 Definition

Blocking immunity for bit stream is a measure of the capability of the receiver to receive the wanted modulated signal at the *nominal frequency* without exceeding a given degradation due to the presence of an unwanted unmodulated high input signal.

It is specified as the ratio in decibels of the level of the unwanted signal to a specified level of the wanted signal at the receiver input for which the bit error ratio is 10^{-2}.

4.3.6.2.2 Method of measurement

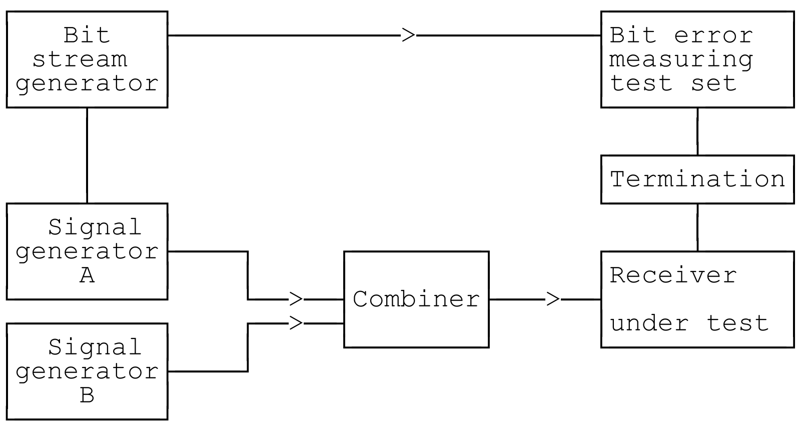


Figure 39: Measurement arrangement

a) 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-M2*.

b) 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 the *wanted signal level* when measured at the receiver input.

c) The unwanted signal shall be unmodulated and its frequency shall be varied between +1 MHz and +10 MHz, also between -1 MHz and -10 MHz relative to the nominal frequency of the receiver. However for practical reasons the measurements shall be carried out at certain frequencies of the unwanted signal at approximately ±1 MHz, ±2 MHz, ±5 MHz and ±10 MHz. Any of these frequencies shall be one at which no spurious response has been detected. The level of the unwanted signal shall be adjusted until a bit error ratio of less then 10^{-1} is obtained.

d) The wanted signal shall then be transmitted whilst observing the bit error ratio. The level of the unwanted signal shall be reduced in steps of 1 dB until a bit error ratio of 10-^{2} or better is obtained. The level of the unwanted signal shall then be recorded in each case.

e) The blocking level for bit stream is recorded as the lower value of the ratios in dB, of each measurement above, of the level of the unwanted signal to the level of the wanted signal, at the receiver input.

4.3.6.3 Blocking immunity for messages

4.3.6.3.1 Definition

Blocking immunity for messages is a measure of the capability of the receiver to receive the wanted modulated signal at the nominal frequency without exceeding a given degradation due to the presence of an unwanted unmodulated high input signal.

It is specified as the ratio in decibels 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 %.

4.3.6.3.2 Method of measurement

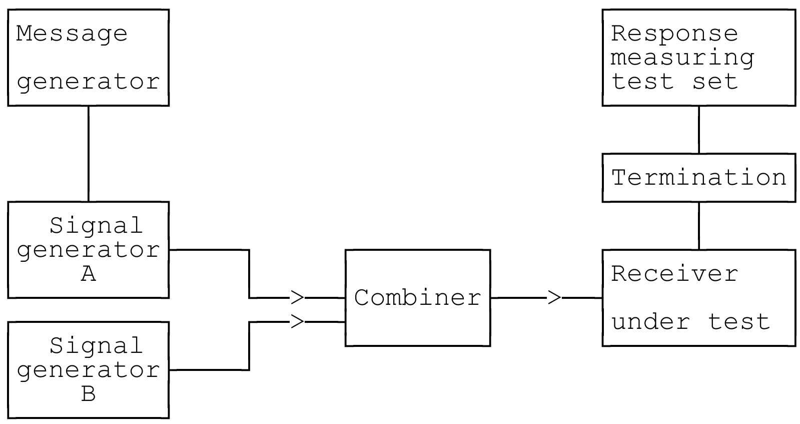


Figure 40: Measurement arrangement

a) 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.*

b) 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 the wanted signal level when measured at the receiver input.

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

d) 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 recorded.

e) 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 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 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.

f) Repeat the measurements for frequency of the unwanted signal selected in the range -1 MHz ±10 % relative to the *nominal frequency* of the receiver.

g) The blocking level for messages is recorded as the lower value of the ratios in dB, of the two measurements above, of the average of the levels of the unwanted signal recorded in steps d) and e) to the level of the wanted signal.

4.3.7 Conducted spurious components

4.3.7.1 Definition

Conducted spurious components are discrete radio frequency signals conveyed from the antenna socket by conduction to the *test load*.

They are specified as the power level of any discrete signal delivered into a *test load* within the specified frequency range.

4.3.7.2 Method of measurement

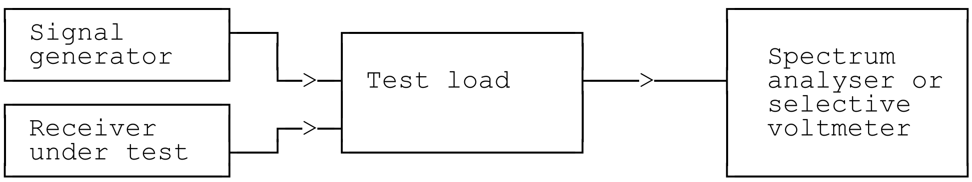


Figure 41: Measurement arrangement

A *test load* may be used to protect the spectrum analyser or selective voltmeter against damage when testing a receiver combined in one unit with a transmitter.

The spectrum analyser or selective voltmeter used shall have sufficient dynamic range and sensitivity to achieve the required measurement accuracy at the specified limit.

a) The receiver input terminals shall be connected to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω and the receiver is switched on.

b) The frequency of the spectrum analyser or selective voltmeter shall be adjusted over the specified frequency range. The frequency and the absolute power level of each of the spurious components found shall be recorded.

c) If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by replacing the receiver by the signal generator and adjusting it to reproduce the frequency and level of every spurious component recorded in step b). The absolute power level of each spurious component shall be recorded.

4.3.8 Amplitude characteristic for analogue speech

4.3.8.1 Definition

The amplitude characteristic for analogue speech of the receiver is the relationship between the radio frequency input level and the audio frequency level at the receiver output.

4.3.8.2 Method of measurement

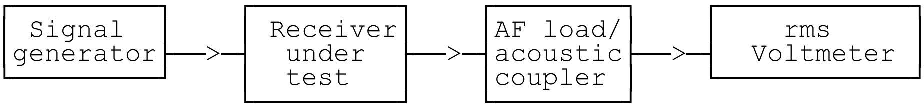


Figure 42: Measurement arrangement

a) A signal generator shall be connected to the receiver input. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by *test modulation A-M1* and shall be adjusted to the *wanted signal level*. The audio output shall be adjusted to give a level of approximately 25 % of the *rated audio output power.* The level shall be recorded.

b) The input signal shall be increased to an emf of +100 dB/µV and the level of the audio output shall be recorded.

c) The amplitude characteristics of the receiver is recorded as the change of level of the audio output measured in steps a) and b) above expressed in dB.

4.3.9 Audio frequency response for analogue speech

4.3.9.1 Definition

The audio frequency response for analogue speech is the variation of the level of the audio frequency output of the receiver as a function of change of the frequency of the modulation.

4.3.9.2 Method of measurement

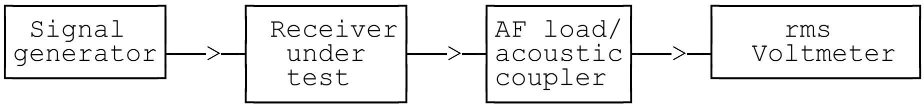


Figure 43: Measurement arrangement

a) An *audio frequency load* and an rms voltmeter shall be connected to the receiver output terminals. A signal generator at the *nominal frequency* of the receiver and with *test modulation A-M1* shall be connected to the receiver input.

b) The signal generator output shall be adjusted to a level of +60 dB/µV emf. 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*.

c) The frequency deviation at 1000 Hz shall be reduced to 20 % of the *maximum permissible frequency deviation*. The deviation shall remain constant while the modulating frequency is varied between 300 Hz and its *upper audio frequency limit*.

d) The variation of the receiver output shall be recorded at suitable intervals of modulation frequency.

e) The measurement shall be repeated with the carrier frequency offset by plus and minus half the absolute limit value of the frequency tolerance for the corresponding transmitter.

4.3.10 Harmonic distortion for analogue speech

4.3.10.1 Definition

The harmonic distortion for analogue speech of a receiver output is the ratio, expressed as a percentage, of the rms voltage of all the harmonic components of the fundamental audio frequency to the total rms voltage at the output.

4.3.10.2 Method of measurement

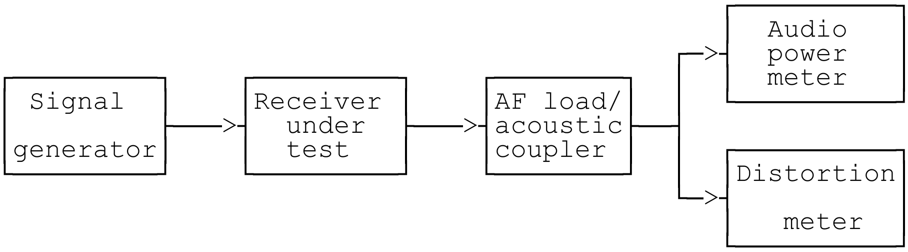


Figure 44: Measurement arrangement

a) An *audio frequency load*, audio power meter and a distortion meter shall be connected to the receiver output terminal. A signal generator at the *nominal frequency* of the receiver and with *test modulation A-M1* shall be connected to the receiver input.

b) The signal generator level shall be adjusted to a level of +60 dB/µV emf and the receiver volume control shall be adjusted to the manufacturers *rated audio output power* into the stated resistive load. In the case of a stepped power control it shall be the first position which gives a power level not less than the *rated audio output power*.

c)
- Phase modulation: The test signal shall be modulated successively at frequencies of 300 Hz, 500 Hz and 1000 Hz maintaining a constant modulation index (i.e. keeping the ratio of frequency deviation to the modulating frequency constant. This is the index which produces 60 % of the *maximum permissible frequency deviation* when modulated at 1000 Hz.
- Frequency modulation: The test signal shall be modulated successively at frequencies of 300 Hz, 500 Hz and 1000 Hz with a frequency deviation equal to 60 % of the *maximum permissible frequency deviation.*

d) The harmonic distortion shall be measured and recorded at each of the frequencies.

e) The tests b) to d) above shall be repeated with the signal generator output at a level of +100 dB/µV emf.

f) The measurement shall be repeated under *extreme test conditions* with the modulating signal at 1000 Hz and the frequency deviation equal to 70 % of the *maximum permissible frequency deviation* at the *nominal frequency* and also with the carrier frequency offset by plus and minus half the limit value of the frequency tolerance for the corresponding transmitter.

4.3.11 Hum and noise for analogue speech

4.3.11.1 Definition

The "hum and noise" of a receiver for analogue speech is the ratio, expressed in decibels, of the audio frequency power output produced by a radio frequency test signal without modulation to the audio frequency power output produced by a signal with specified test modulation.

4.3.11.2 Method of measurement

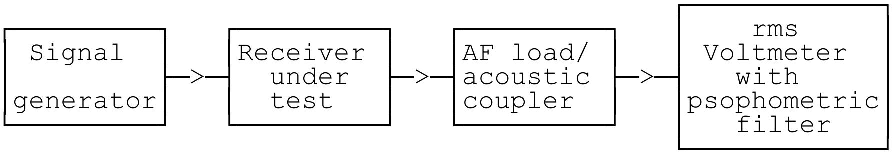


Figure 45: Measurement arrangement

a) An *audio frequency load* and an rms voltmeter with *psophometric weighting network* shall be connected to the receiver output terminals.

b) A signal generator shall be connected to the receiver input. The signal generator shall be at the *nominal frequency* of the receiver and shall have *test modulation A-M1.* The signal generator output shall be adjusted to a level of +30 dB/µV emf.

c) The receiver volume control shall be adjusted to the manufacturers *rated audio output power* into the stated resistive load. In the case of a stepped power control it shall be the first position which gives a power level not less than the *rated audio output power*.

d) The output level shall be recorded.

e) The modulation shall be removed and the new level recorded.

f) The "hum and noise" for analogue speech shall be recorded as is the ratio of the values recorded in steps e) and d) expressed in dB.

4.3.12 Multipath sensitivity

4.3.12.1 Multipath sensitivity for bit stream

4.3.12.1.1 Definition

The multipath sensitivity for bit stream of the receiver is the rms value of the level of a Rayleigh fading signal, at the receiver input, at the *nominal frequency* of the receiver with *test modulation D-M2* signal which produces a bit error ratio of 10^{-2}.

4.3.12.1.2 Method of measurements

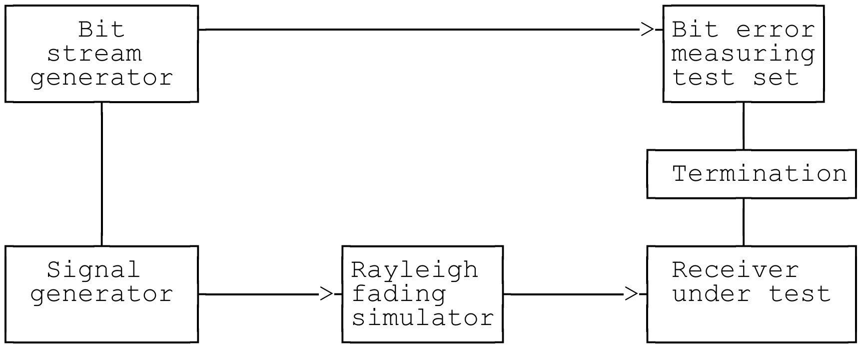


Figure 46: Measuring arrangement

The Rayleigh fading simulator may consist of two uncorrelated digital pseudorandom generators with third order digital filters to shape the noise power spectra. The bandwidth corresponds to the doppler shift of the simulated speed. The two noise sources modulate two RF signals 90 degrees out of phase. The combined signal has a Rayleigh distributed amplitude. Diversity reception Rayleigh fading simulators should have a cross-correlation coefficient less than O.1.

a) The signal generator shall be connected to the receiver input via a Rayleigh fading simulator, adjusted for a 10 km/hour simulated vehicle speed. The signal generator shall be at the *nominal frequency* of the receiver and shall have *test modulation D-M2.*

b) The method of measurement of measured usable sensitivity for bit stream shall then be applied, except that the minimum length of the bit pattern shall be 2500 bits or:

$$\frac{43200 \times (\text{bit rate})}{(\text{vehicle speed in km/h}) \times (\text{operating frequency in MHz})}$$

which ever is the greater.

c) If an error correcting code is used the measurement shall be repeated for the other specified values for the vehicle speed.

d) The amplitude of the signal at the input of the receiver shall be adjusted until a bit error ratio of 10^{-2} is obtained.

e) The rms value of the level applied at the input of the receiver shall be recorded (in dBV emf) as being the multipath sensitivity.

f) Whenever needed, the degradation factor of the measured usable sensitivity for bit stream due to the effect of fading shall be obtained by the difference between the value recorded in step e and the corresponding value recorded previously (as defined in subclause 4.3.1.2 step c).

g) Return to step a, apply a 50 km/hour simulated vehicle speed and repeat steps b to f.

h) Return to step a, apply a 90 km/hour simulated vehicle speed and repeat steps b to f.

4.3.12.2 Multipath sensitivity for messages

4.3.12.2.1 Definition

The multipath sensitivity for messages of the receiver is the rms value of the level of a Rayleigh fading signal, at the receiver input, at the *nominal frequency* of the receiver with *test modulation D-M3* signal which produces a specified successful message ratio of 80 %.

4.3.12.2.2 Method of measurements

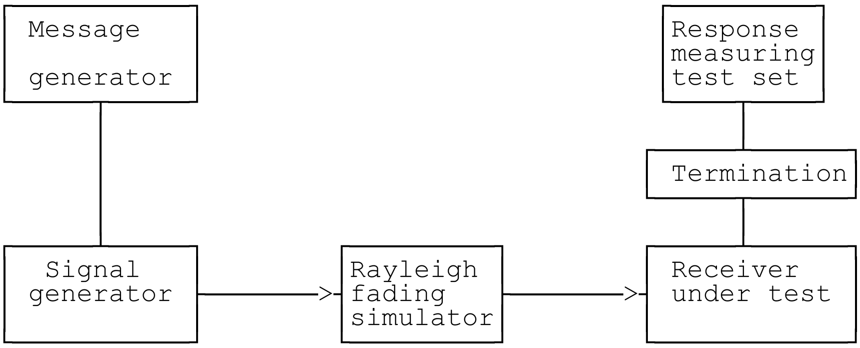


Figure 47: Measuring arrangement

The Rayleigh fading simulator may consist of two uncorrelated digital pseudorandom generators with third order digital filters to shape the noise power spectra. The bandwidth corresponds to the doppler shift of the simulated speed. The two noise sources modulate two RF signals 90 degrees out of phase. It can be shown that the combined signal has a Rayleigh distributed amplitude. Diversity reception Rayleigh fading simulators should have a cross-correlation coefficient less than O.1.

a) The signal generator shall be connected to the receiver input via a Rayleigh fading simulator, adjusted for a 90 km/hour simulated vehicle speed. The signal generator shall be at the *nominal frequency* of the receiver and shall have *test modulation D-M2*.

b) The method of measurement of measured usable sensitivity for messages steps b) to d) shall then be used.

c) The multipath sensitivity for messages is the average of the values recorded in step b.

d) Whenever needed, the degradation factor of the measured usable sensitivity for messages due to the effect of fading shall be obtained by the difference between the value recorded in step c and the corresponding value recorded previously (as defined in subclause 4.3.1.3 step e).

e) Return to step a, apply a 50 km/hour simulated vehicle speed and repeat steps b to d.

f) Return to step a, apply a 90 km/hour simulated vehicle speed and repeat steps b to d.

4.3.13 Bit error ratio

4.3.13.1 Definition

The bit error ratio is the ratio of the number of bits incorrectly received to the total number of bits received.

4.3.13.2 Method of measurement

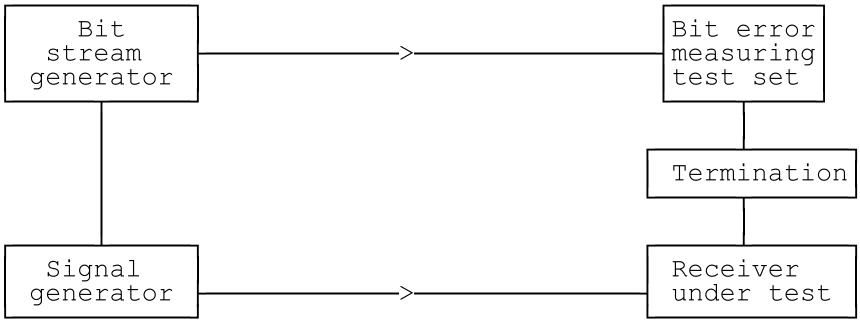


Figure 48: Measurement arrangement

a) A signal generator shall be connected to the receiver input. The signal generator shall be, at the *nominal frequency* and shall have *test modulation D-M2.*

b) The amplitude at the signal generator shall be adjusted to a level at 30 dB above the level of the *wanted signal level.*

c) The number of errors that occur at the receiver output, during a period of 3 minutes, is counted.

d) The bit error ratio shall be recorded as the ratio of the number of bits incorrectly received to the total number of bits received.

e) The measurement shall be repeated with the input signal of the receiver at a level of 100 dB above the level of the *wanted signal level.*

4.3.14 Opening delay for data

4.3.14.1 Definition

The receiver opening delay is the time which elapses between the application of a test signal to the receiver and the establishment of the receiving condition.

4.3.14.2 Method of measurement

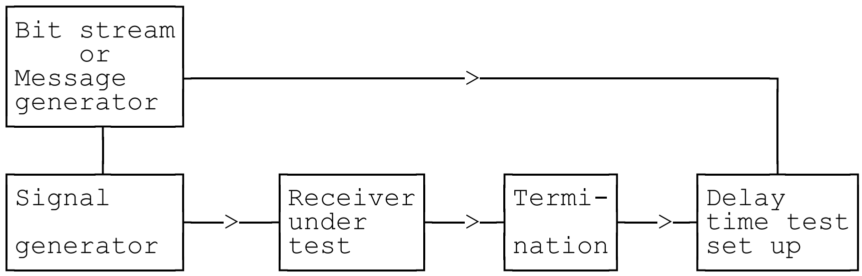


Figure 49: Measuring arrangement

a) A signal generator shall be connected to the receiver input. The signal generator shall be at the *nominal frequency* and shall be adjusted to give a signal level at the receiver input 20 db above the *wanted signal level*.

b) The signal generator shall have *test modulation D-M2* or *D-M3*.

c) When the *D-M3* is used, the measurement is repeated three times.

d) The delay between the application of the test signal to the receiver and the establishment of the receiving condition is measured.

4.4 Duplex operation

All measurements described in this subclause are very critical and require high decoupling between the transmitter and the signal generators in use.

4.4.1 Spurious response immunity (duplex)

4.4.1.1 Spurious response immunity (duplex) for analogue speech

4.4.1.1.1 Definition

The spurious response immunity (duplex) for analogue speech is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the *nominal frequency* and an unwanted signal at any other frequency at which a response is obtained, in the presence of a transmitter working simultaneously with the receiver under duplex operation.

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

4.4.1.1.2 Method of measurement

Two methods are described covering equipments with combined one or two antenna sockets. In each measuring arrangement additional attenuators (not shown) may be required to avoid producing spurious signals by intermodulation in the test apparatus.

A) Equipment operating with one antenna

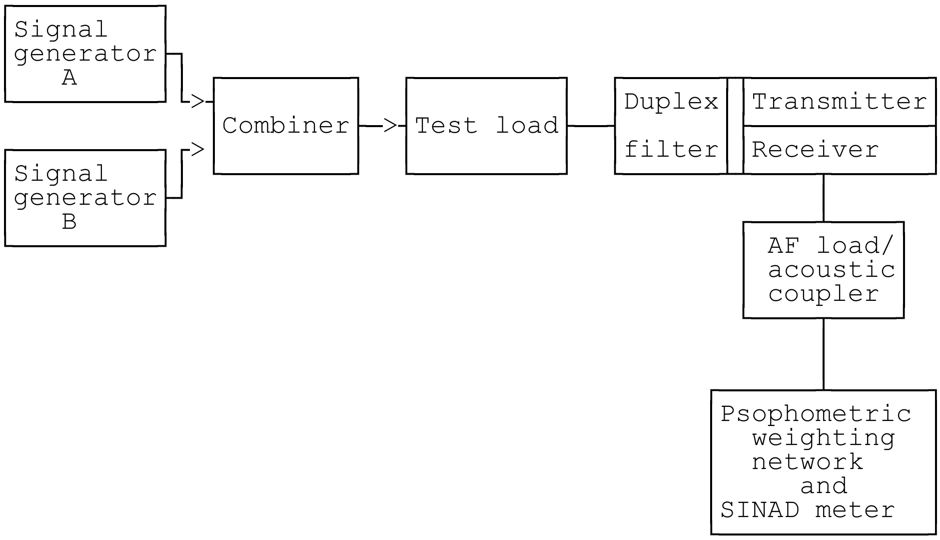


Figure 50: Measurement arrangement

a) The antenna terminal of the equipment comprising the receiver, transmitter and *duplex filter* shall be connected to a *test load.*

b) The transmitter shall operate at the maximum *rated RF output power* and shall be unmodulated.

c) Two signal generators A and B shall be connected to the receiver input via a *combining network* and the *test load* so that they do not affect the impedance matching. The wanted signal, represented by signal generator A, shall be at the nominal frequency and shall have *test modulation A-M1*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3*.

d) Repeat steps b) to d) of the spurious response immunity measurement for analogue speech (subclause 4.3.4.1).

This measurement shall be performed around the measuring frequencies f_m derived from the expressions:

$p \times f_t + q \times f_m = f_r$ and $f_m = n \times f_t \pm f_{i1}$

where f_t is the transmitter frequency, f_r is the receiver frequency and f_{i1} is the frequency of the first intermediate frequency of the receiver. P, q and n are integer numbers.

A particular attention is drawn to the following values:

p = -1, q = 2 and p = 2, q = -1.

B) Equipment operating with two antennas

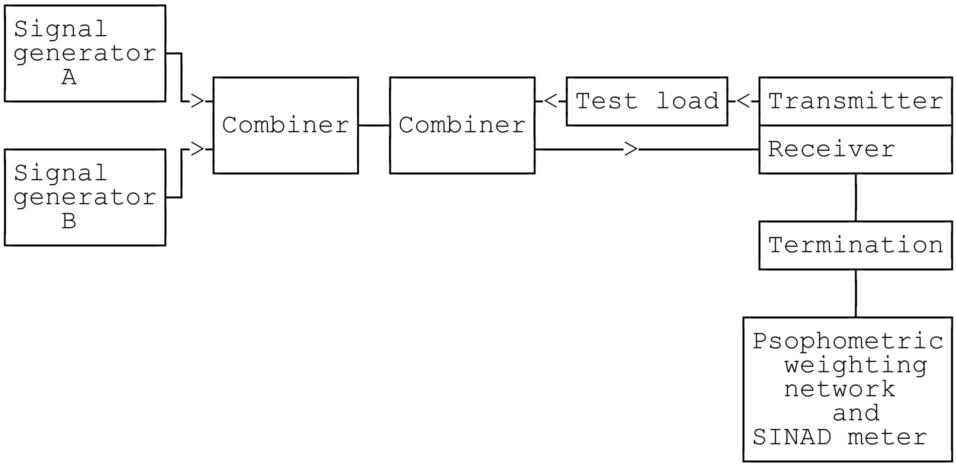


Figure 51: Measurement arrangement

a) The transmitter shall be connected to a *test load* to dissipate the *rated RF output power* of the transmitter the rating of which is declared by the manufacturer. The *test load* output shall be connected to the receiver input by means of a *combining network*. The total attenuation between transmitter and receiver has to be adjusted to be 30 dB.

b) The transmitter shall operate at the maximum *rated RF output po*wer and shall be unmodulated.

c) Two signal generators A and B shall be connected to the receiver input via the two *combining networks* so that they do not affect the impedance matching. The wanted signal, represented by signal generator A, shall be at the nominal frequency and shall have *test modulation AM-1.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3.*

d) Repeat steps b) to d) of the spurious response immunity measurement for analogue speech (subclause 4.3.4.1).

This measurement shall be performed around frequencies f_m derived from the expressions:

$p \times f_t + q \times f_m = f_r$ and $f_m = n \times f_t \pm f_if_1$

where f_t is the transmitter frequency, f_r is the receiver frequency and f_if_1 is the frequency of the first intermediate frequency of the receiver. P, q and n are integer numbers.

A particular attention is drawn to the following values:

p = -1, q = 2 and p = 2, q = -1.

4.4.1.2 Spurious response immunity for bit stream (duplex)

4.4.1.2.1 Definition

The spurious response immunity for bit stream (duplex) is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the *nominal frequency* and an unwanted signal at any other frequency at which a response is obtained, in the presence of a transmitter working simultaneously with the receiver under duplex operation.

It is specified as the ratio in decibels of the level of the unwanted signal to the level of the wanted signal at the receiver input for which the bit error ratio is 10^{-2}.

4.4.1.2.2 Method of measurement

Two methods are described covering equipments with combined one or two antenna sockets. In each measuring arrangement additional attenuators (not shown) may be required to avoid producing spurious signals by intermodulation in the test apparatus.

A) Equipment operating with one antenna

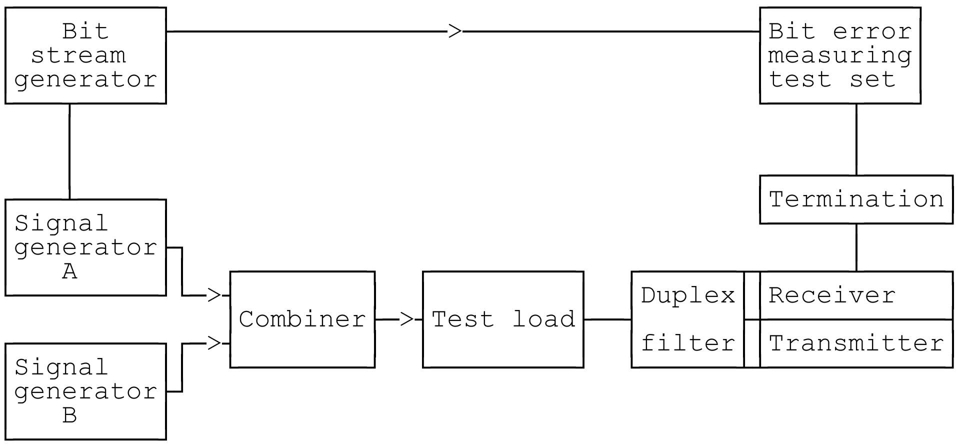


Figure 52: Measurement arrangement

a) The antenna terminal of the equipment comprising the receiver, transmitter and *duplex filter* shall be connected to a *test load*.

b) The transmitter shall operate at the maximum *rated RF output power* and shall be unmodulated.

c) Two signal generators A and B shall be connected to the receiver input via a *combining network* and the *test load* so that they do not affect the impedance matching. The wanted signal, represented by signal generator A, shall be at the nominal frequency of the receiver and shall have *test modulation D-M2*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur.

d) Repeat steps b) to f) of the spurious response immunity measurement for bit stream (subclause 4.3.4.2).

This measurement shall be performed around frequencies f_m derived from the expressions:

$p \times f_t + q \times f_m = f_r$ and $f_m = n \times f_t \pm f_i f_1$

where f_t is the transmitter frequency, f_r is the receiver frequency and $f_i f_1$ is the frequency of the first intermediate frequency of the receiver. P, q and n are integer numbers.

A particular attention is drawn to the following values:

p = -1, q = 2 and p = 2, q = -1.

B) Equipment operating with two antennas

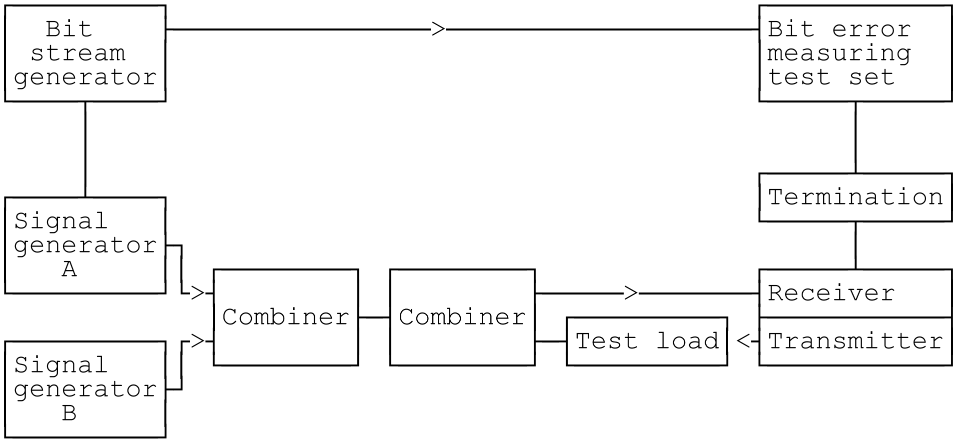


Figure 53: Measurement arrangement

a) The transmitter shall be connected to an *test load* to dissipate the *rated radio frequency output power* of the transmitter the rating of which is declared by the manufacturer. The *test load* output shall be connected to the receiver input by means of a *combining network*. The total attenuation between transmitter and receiver has to be adjusted to be 30 dB.

b) The transmitter shall operate at the maximum *rated RF output power* and shall be unmodulated.

c) Two signal generators A and B shall be connected to the receiver input via the two *combining networks* so that they do not affect the impedance matching. The wanted signal, represented by signal generator A, shall be at the *nominal frequency* of the receiver and shall have *test modulation D-M2.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur.

d) Repeat steps b) to f) of the spurious response immunity measurement for bit stream (subclause 4.3.4.2).

This measurement shall be performed around frequencies f_m derived from the expressions:

$p \times f_t + q \times f_m = f_r$ and $f_m = n \times f_t \pm f_i f_1$

where f_t is the transmitter frequency, f_r is the receiver frequency and $f_i f_1$ is the frequency of the first intermediate frequency of the receiver. P, q and n are integer numbers.

A particular attention is drawn to the following values:

p = -1, q = 2 and p = 2, q = -1.

4.4.1.3 Spurious response immunity for messages (duplex)

4.4.1.3.1 Definition

The spurious response immunity for messages (duplex) is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the *nominal frequency* and an unwanted signal at any other frequency at which a response is obtained, in the presence of a transmitter working simultaneously with the receiver under duplex operation.

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

4.4.1.3.2 Method of measurement

Two methods are described covering equipments with combined one or two antenna sockets. In each measuring arrangement additional attenuators (not shown) may be required to avoid producing spurious signals by intermodulation in the test apparatus.

A) Equipment operating with one antenna

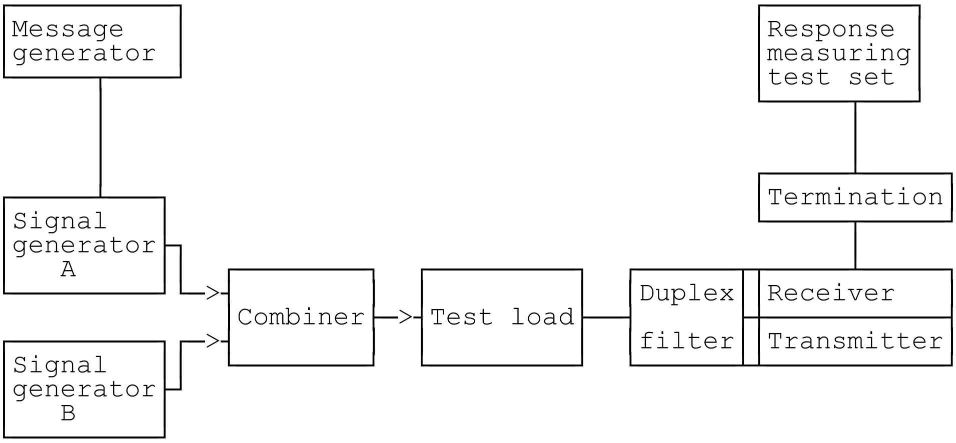


Figure 54: Measurement arrangement

a) The antenna terminal of the equipment comprising the receiver, transmitter and *duplex filter* shall be connected to a *test load.*

b) The transmitter shall operate at the maximum *rated RF output power* and shall be unmodulated.

c) Two signal generators, A and B shall be connected to the receiver via a *combining network* and the *test load* so they do not affect the impedance matching. The wanted signal, represented by signal generator A, shall be at the *nominal frequency* and shall have *test modulation D-M3.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is anticipated that a spurious response could occur.

d) Repeat steps b) to g) of the spurious response immunity measurement for messages (subclause 4.3.4.3).

This measurement shall be performed around frequencies f_m derived from the expressions:

$p \times f_t + q \times f_m = f_r$ and $f_m = n \times f_t \pm f_i f_1$

where f_t is the transmitter frequency, f_r is the receiver frequency and $f_i f_1$ is the frequency of the first intermediate frequency of the receiver. P, q and n are integer numbers.

A particular attention is drawn to the following values:

p = -1, q = 2 and p = 2, q = -1.

B) Equipment operating with two antennas

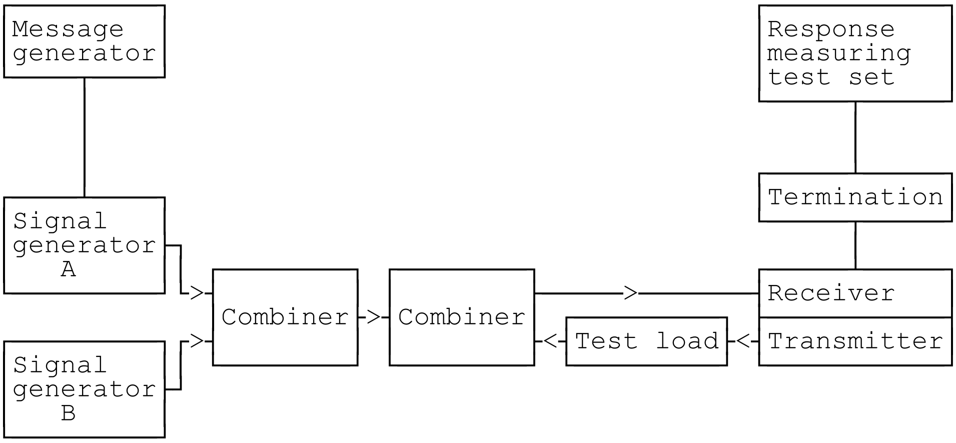


Figure 55: Measurement arrangement

a) The transmitter shall be connected to an *test load* to dissipate the *rated RF output power* of the transmitter the rating of which is declared by the manufacturer. The *test load* output shall be connected to the receiver input by means of a *combining network*. The total attenuation between transmitter and receiver has to be adjusted to be 30 dB.

b) The transmitter shall operate at the maximum *rated RF output powe*r and shall be unmodulated.

c) Two signal generators, A and B shall be connected to the receiver via a the two *combining networks* so they do not affect the impedance matching. The wanted signal, represented by signal generator A, shall be at the *nominal frequency* and shall have *test modulation D-M3.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur.

d) Repeat steps b) to g) of the spurious response immunity measurement for messages (subclause 4.3.4.3).

This measurement shall be performed around frequencies f_m derived from the expressions:

$p \times f_t + q \times f_m = f_r$ and $f_m = n \times f_t \pm f_i f_1$

where f_t is the transmitter frequency, f_r is the receiver frequency and $f_i f_1$ is the frequency of the first intermediate frequency of the receiver. P, q and n are integer numbers.

A particular attention is drawn to the following values:

p = -1, q = 2 and p = 2, q = -1.

4.4.2 Desensitisation (duplex)

4.4.2.1 Desensitisation for analogue speech (duplex)

4.4.2.1.1 Definition

The desensitisation for analogue speech (duplex) is the degradation of the sensitivity of the receiver resulting from the transfer of power from the transmitter to the receiver due to unwanted coupling effects.

It is specified as the difference, in decibels, of the levels of measured usable sensitivity for analogue speech with simultaneous transmission and without.

4.4.2.1.2 Method of measurement

A) Equipment operating with one antenna

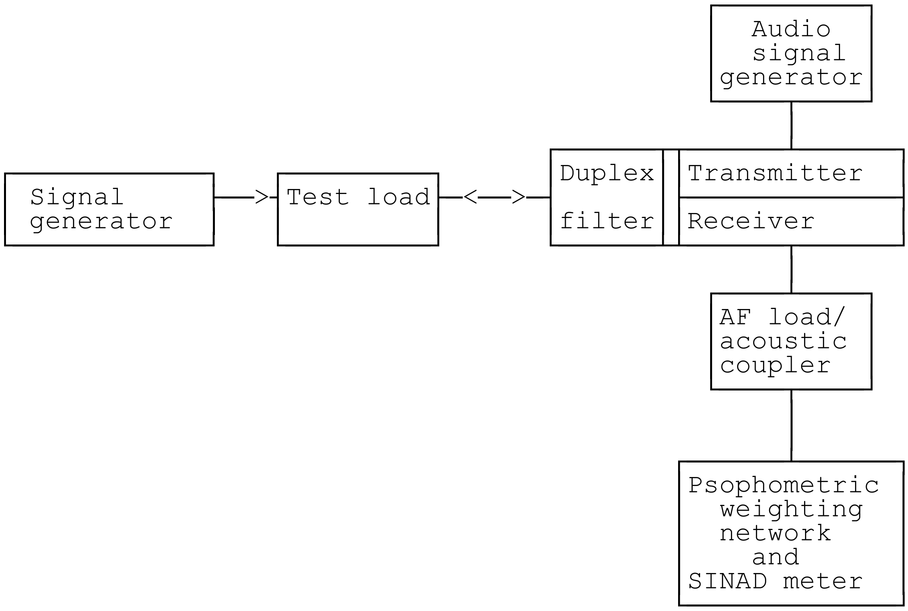


Figure 56: Measurement arrangement

a) The antenna terminal of the equipment comprising the receiver, transmitter and *duplex filter* shall be connected to a *test load.*

b) A signal generator at the *nominal frequency* and with *test modulation A-M1* shall be connected to the *test load* so that it does not affect the impedance matching.

c) The transmitter shall operate at the maximum *rated RF output power* and shall have *test modulation A-M3.*

d) The receiver measured usable sensitivity for analogue speech shall then be measured through a *psophometric weighting network* and the output level of the signal generator shall be recorded in dB/µV.

e) The transmitter shall then be switched off, the receiver measured usable sensitivity for analogue speech shall again be measured and the output level of the signal generator shall be recorded in dB/µV.

f) The desensitisation for analogue speech (duplex) is recorded as the difference between the values recorded in steps d) and e).

B) Equipment operating with two antennas

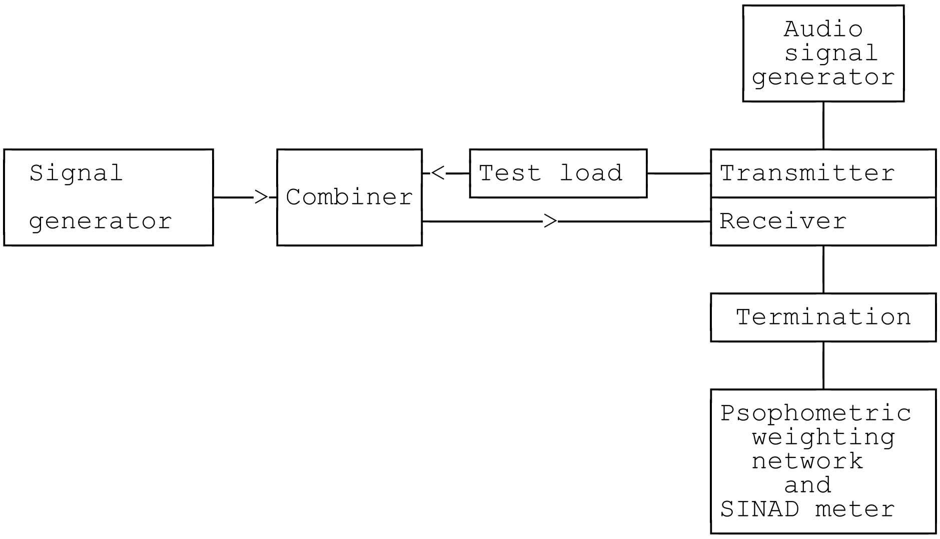


Figure 57: Measurement arrangement

a) The transmitter shall be connected to a *test load* to dissipate the *rated radio frequency output power* of the transmitter the rating of which is declared by the manufacturer. The *test load* output shall be connected to the receiver input by means of a *combining network*. The total attenuation between transmitter and receiver is adjusted to be 30 dB.

b) A signal generator at the *nominal frequency* and with *test modulation A-M1* shall be connected to the *combining network* in such a way as not to affect the impedance matching.

c) Repeat steps c) to f) of measurement A).

4.4.2.2 Desensitisation for bit stream (duplex)

4.4.2.2.1 Definition

The desensitisation for bit stream (duplex) is the degradation of the sensitivity of the receiver resulting from the transfer of power from the transmitter to the receiver due to unwanted coupling effects.

It is specified as the difference, in decibels, of the levels of measured usable sensitivity for bit stream with simultaneous transmission and without.

4.4.2.2.2 Method of measurement

A) Equipment operating with one antenna

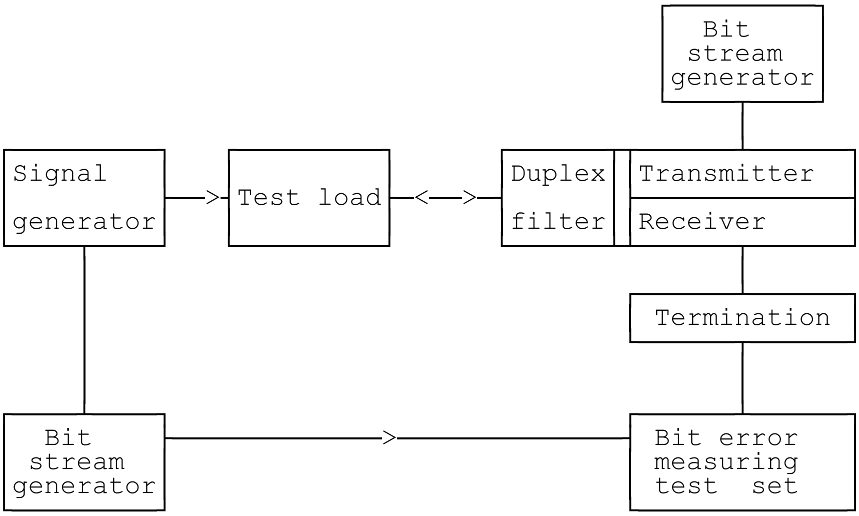


Figure 58: Measurement arrangement

a) The antenna terminal of the equipment comprising the receiver, transmitter and *duplex filter* shall be connected to a *test load*.

b) A signal generator at the *nominal frequency* with *test modulation D-M2* shall be connected to the *test load* so that it does not affect the impedance matching.

c) The transmitter shall operate at the maximum *rated RF output power* with *test modulation D-M2* (which shall start at a different time then the one used in step b)).

d) The receiver measured usable sensitivity for bit stream shall be measured and the output level of the signal generator shall be recorded in dB/µV.

e) The transmitter shall then be switched off, the receiver measured usable sensitivity for bit stream shall again be measured and the output level of the signal generator shall be recorded in dB/µV.

f) The desensitisation for bit stream (duplex) is recorded as the difference between the values recorded in steps d) and e).

B) Equipment operating with two antennas

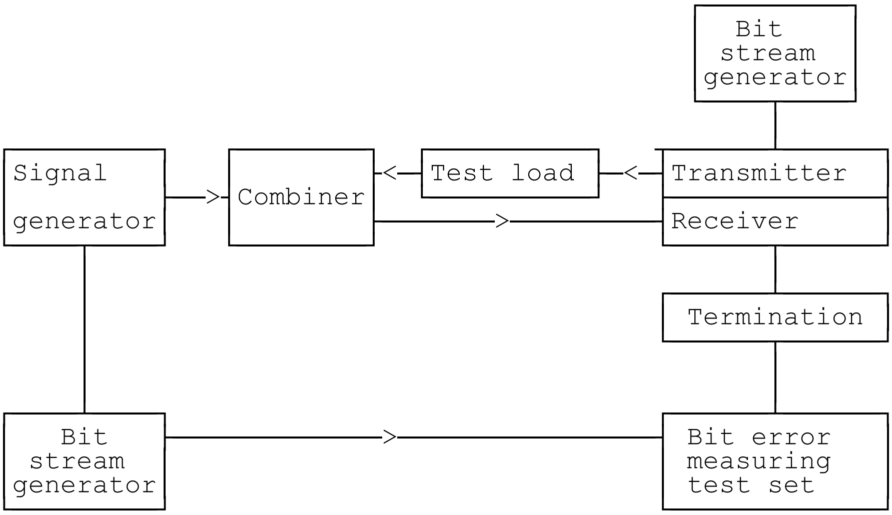


Figure 59: Measuring arrangement

a) The transmitter shall be connected to a *test load* to dissipate the *rated radio frequency output power* of the transmitter the rating of which is declared by the manufacturer. The *test load* output shall be connected to the receiver input by means of a *combining network*. The total attenuation between transmitter and receiver is adjusted to be 30 dB.

b) A signal generator at the *nominal frequency* of the receiver with *test modulation D-M2* shall be connected to the *combining network* in such a way as not to affect the impedance matching.

c) Repeat steps c) to f) of measurement A).

4.4.2.3 Desensitisation for messages (duplex)

4.4.2.3.1 Definition

The desensitisation for messages (duplex) is the degradation of the sensitivity of the receiver resulting from the transfer of power from the transmitter to the receiver due to unwanted coupling effects.

It is specified as the difference, in decibels, of the levels of measured usable sensitivity for messages with simultaneous transmission and without.

4.4.2.3.2 Method of measurement

A) Equipment operating with one antenna

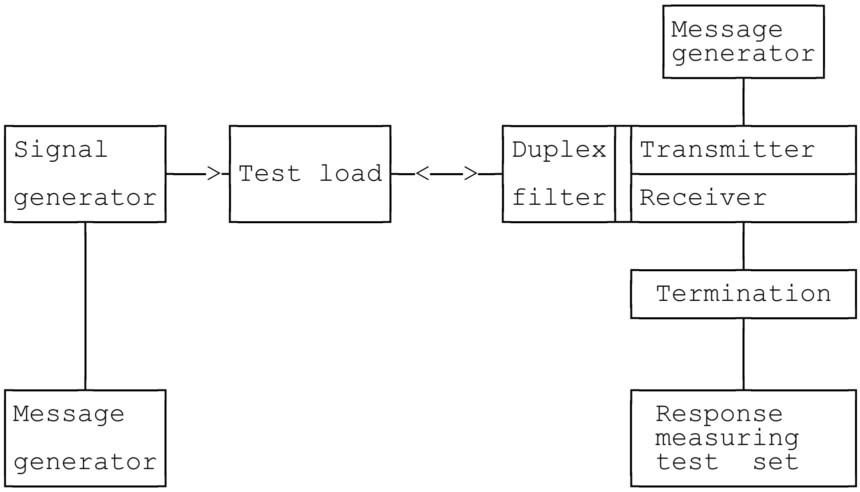


Figure 60: Measurement arrangement

a) The antenna terminal of the equipment comprising the receiver, transmitter and *duplex filter* shall be connected to a *test load.*

b) A signal generator at the *nominal frequency* of the receiver with *test modulation D-M3* shall be connected to the *test load* so that it does not affect the impedance matching.

c) The transmitter shall operate at the maximum *rated RF output power* with *test modulation D-M3* (which shall use a different message and start at a different time then the one used in step b)).

d) The receiver measured usable sensitivity for messages shall then be measured and the output level of the signal generator shall be recorded in dB/µV.

e) The transmitter shall then be switched off, the receiver measured usable sensitivity for messages shall again be measured and the output level of the signal generator shall be recorded in dB/µV.

f) The desensitisation for messages (duplex) is recorded as the difference between the values recorded in steps d) and e).

B) Equipment operating with two antennas

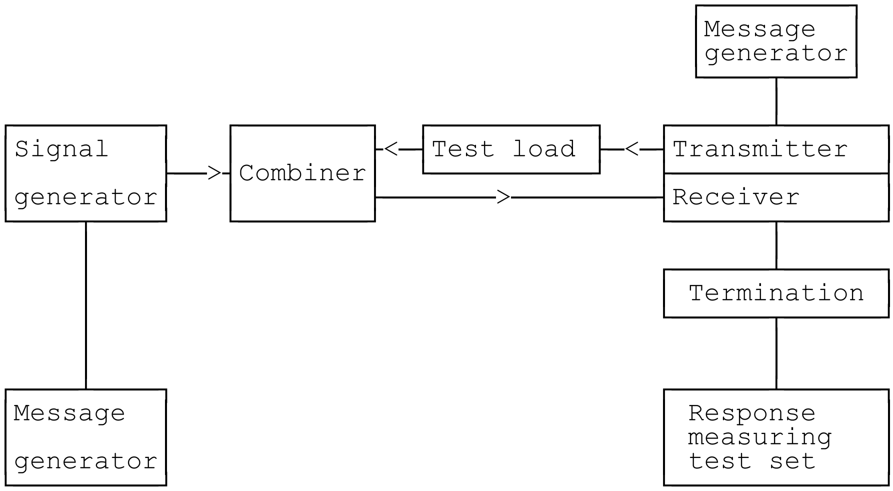


Figure 61: Measurement arrangement

a) The transmitter shall be connected to a *test load* to dissipate the *rated radio frequency output power* of the transmitter the rating of which is declared by the manufacturer. The *test load* output shall be connected to the receiver input by means of a *combining network*. The total attenuation between transmitter and receiver has to be 30 dB.

b) A signal generator at the *nominal frequency* of the receiver with *test modulation D-M3* shall be connected to the *combining network* in such a way as not to affect the impedance matching.

c) Repeat steps c) to f) of measurement A).

5 Radiated measurements

5.1 General

This Clause contains all methods of measurements involving the absolute measurement of a radiated field. This field may be radiated by an integral antenna and/or by the cabinet of the equipment itself.

The standard test site will be a calibrated **open air test site**, whose dimensions are appropriate to the frequency range of measurements.

In some cases operating on a **test site** may produce electromagnetic perturbation or, conversely, external radiations may disturb the measurement. For these reasons, and also in order to reduce the space required, other arrangements may be used, such as:

- **stripline arrangement**s,
- **anechoic chamber**,
- **indoor test site**.

The methods of measurement described in this chapter are based on an **open air test site**, unless otherwise stated. If a **stripline arrangement**, an **anechoic chamber or an indoor test site** are used, the changes which apply to the method of measurement are indicated in their corresponding descriptions. For each radiated measurement, the nature and the dimensions of the test arrangement used shall be recorded in the test report.

For *extreme test conditions* a **test fixture** will also be required.

For equipment normally operated from internal batteries it may be necessary to operate it from an external power source. A RF filter may be required to avoid radiation to or from the power leads.

5.2 Transmitter

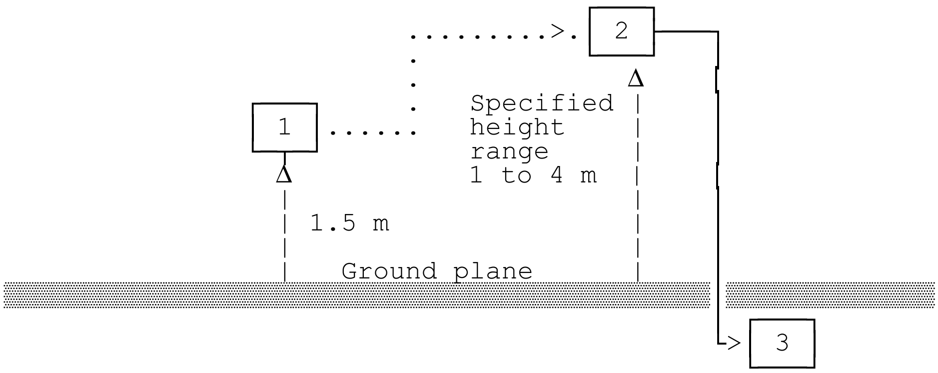
When conducting transmitter tests on equipment designed for intermittent operation, the specified maximum transmit time shall not be exceeded.

5.2.1 Maximum carrier radiated power

5.2.1.1 Definition

For the purpose of this measurement, the maximum carrier radiated power is defined as the effective radiated power in the direction of maximum field strength under specific conditions of measurement and preferably in the absence of modulation.

5.2.1.2 Method of measurement



1. Transmitter under test
2. Test antenna
3. Spectrum analyser or selective voltmeter

Figure 62: Measuremement arrangement N°1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used. The **test antenna** shall be oriented initially for vertical polarisation unless otherwise stated. (In some ETS a single polarisation for the test antenna may be specified for the measurements. In this case there is no need to proceed as in step f).

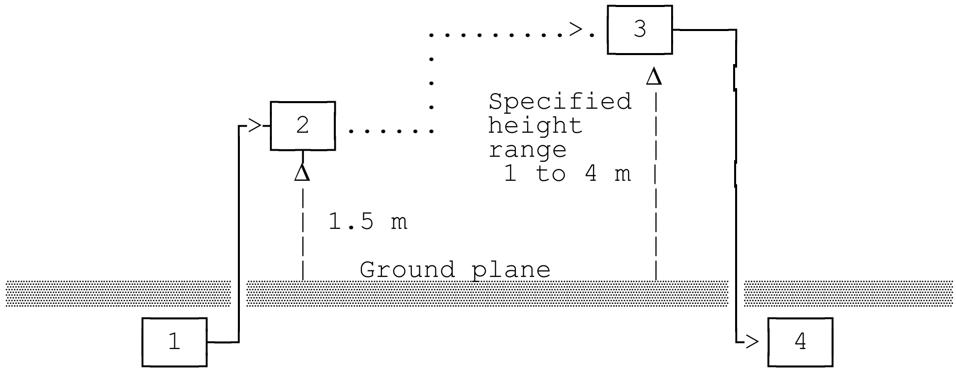
The transmitter under test shall be placed on the support in its **standard position** and switched on without modulation.

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

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

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

(This maximum may be a lower value than the value obtainable at heights outside the specified limits).



1. Signal generator
2. Substitution antenna
3. Test antenna
4. Spectrum analyser or selective voltmeter

Figure 63: Measurement arrangement N°2

e) Using measurement arrangement N°2 the **substitution antenna,** shall replace the transmitter antenna in the same position and in vertical polarisation. The frequency of the signal generator shall be adjusted to the transmitter carrier frequency. The **test antenna** shall be raised or lowered as necessary to ensure that the maximum signal is still received. The input signal to the **substitution antenna** shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver.

The carrier radiated power is equal to the power supplied by the signal generator, increased by the known relationship if necessary and after corrections due to the gain of the **substitution antenna** and the cable loss between the signal generator and the **substitution antenna.**

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

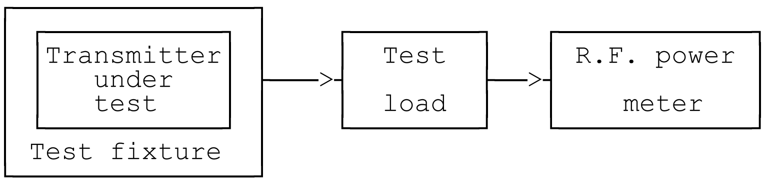


Figure 64: Measurement arrangement N°3

g) The measurement may also be performed under *extreme test conditions*. Due to the impossibility of repeating the above measurement on a **test site** under extreme temperature conditions, only a relative measurement is performed, using a **test fixture** and the measurement arrangement N°3.

h) The power delivered to the *test load* is measured under *normal and extreme test conditions,* and the difference in dB is 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.*

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

5.2.2 Radiated spurious emissions

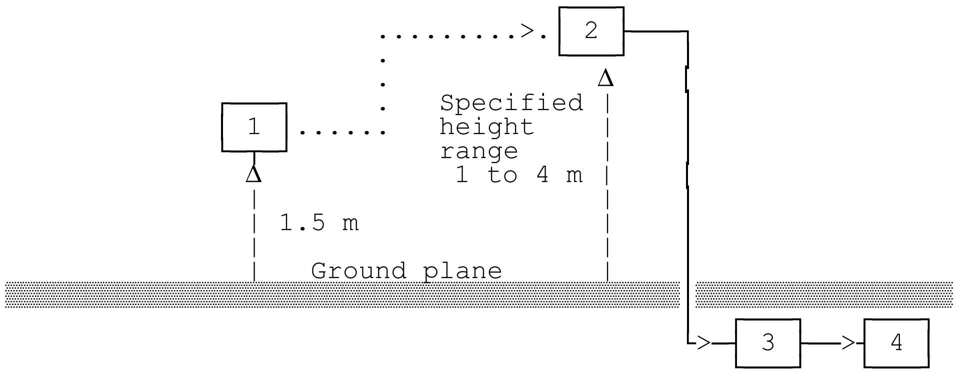
5.2.2.1 Definition

Spurious emissions are emissions at frequencies, other than those of the carrier and sidebands associated with normal modulation, radiated by the antenna and by the cabinet of the transmitter.

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

5.2.2.2 Method of measurement

This method of measurement applies to transmitters having an integral antenna.



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

Figure 65: Measurement arrangement N°1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used. The **test antenna** shall be oriented initially for vertical polarisation and connected to a spectrum analyser or a selective voltmeter, through a suitable filter to avoid overloading of the spectrum analyser or selective voltmeter. The bandwidth of the spectrum analyser or selective voltmeter shall be between 10 and 100 kHz, set to a suitable value to correctly perform the measurement.

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

For the measurement of spurious emissions at and above the second harmonic of the carrier frequency the filter used shall be a high pass filter with a stop band rejection exceeding 40 dB. The cut-off frequency of the high pass filter shall be approximately 1.5 times the transmitter carrier frequency.

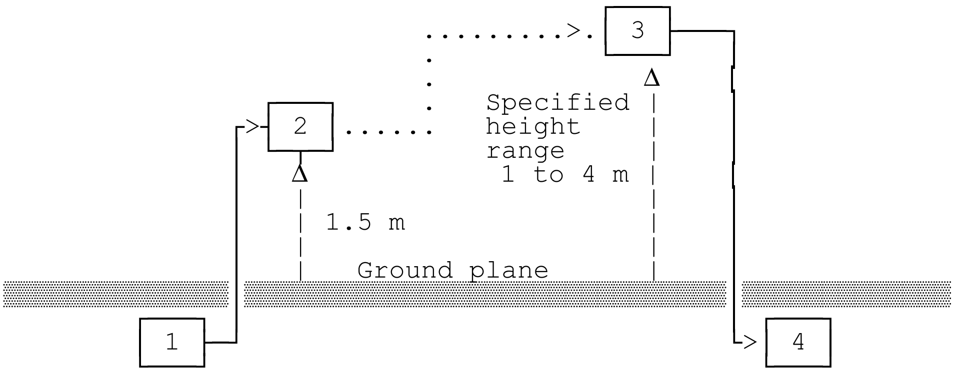
The transmitter under test shall be placed on the support in its **standard position** and shall be switched on without modulation.

b) The radiation of any spurious emission shall be detected by the **test antenna** and spectrum analyser or selective voltmeter over the specified frequency range, except for the channel on which the transmitter is intended to operate and its adjacent channels. The frequency of each spurious emission detected shall be recorded. If the **test site** is disturbed by interference coming from outside, this qualitative search may be performed in a screened room, with a reduced distance between the transmitter and the **test antenna**.

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

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

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



1. Signal generator
2. Substitution antenna
3. Test antenna
4. Spectrum analyser or selective voltmeter

Figure 66: Measurement arrangement N°2

f) Using measurement arrangement N°2 the **substitution antenna** shall replace the transmitter antenna in the same position and in vertical polarisation. It shall be connected to the signal generator.

g) At each frequency at which a emission has been detected, the signal generator, **substitution antenna**, and spectrum analyser or selective voltmeter shall be tuned. The **test antenna** shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter. The level of the signal generator giving the same signal level on the spectrum analyser or selective voltmeter as in item e) above shall be recorded. This value, after corrections due to the gain of the **substitution antenna** and the cable loss between the signal generator and the **substitution antenna,** is the radiated spurious emission at this frequency.

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

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

5.2.3 Cabinet radiation

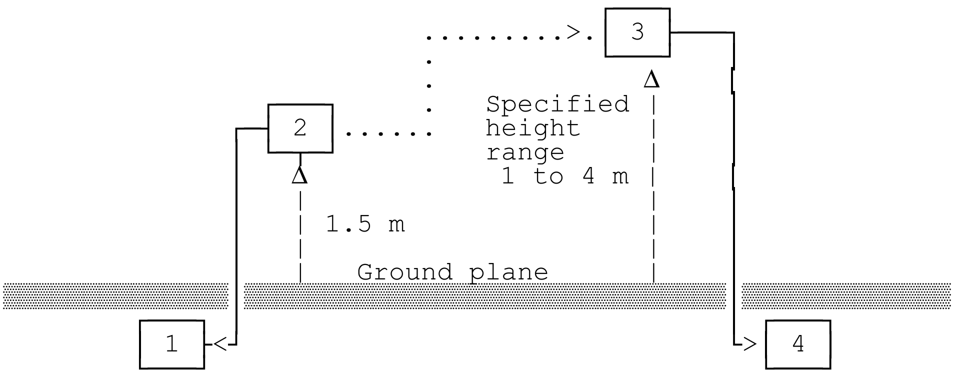
5.2.3.1 Definition

Cabinet radiation is radiation at frequencies, excluding the band containing the carrier and sidebands associated with normal modulation, coming from the cabinet of the transmitter.

It is specified as the radiated power of any discrete signal.

5.2.3.2 Method of measurement

This method of measurement applies to transmitters having an antenna socket.



1. Test load
2. Transmitter under test
3. Test antenna
4. Spectrum analyser or selective voltmeter

Figure 67: Measurement arrangement N°1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used. The **test antenna** shall be oriented initially for vertical polarisation and connected to a spectrum analyser or selective voltmeter. The bandwidth of the spectrum analyser or selective voltmeter shall be between 10 and 100 Khz, set to a suitable value to correctly perform the measurement.

The transmitter under test shall be placed on the support in its **standard position**, connected to a *test load* and switched on without modulation.

b) The same method of measurement as steps b) and i) of subclause 5.2.2 "Radiated spurious emissions" will be used.

5.3 Receiver

For all receiver measurements for analogue speech, unless otherwise stated, the receiver volume control where possible, 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*. This control shall not be readjusted between *normal and extreme test conditions*.

5.3.1 Average measured usable sensivity expressed as field strength

5.3.1.1 Average measured usable sensitivity expressed as field strength for analogue speech

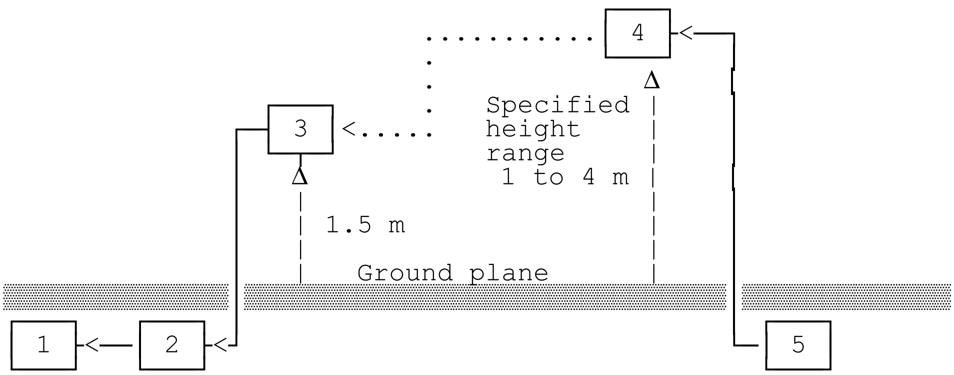
5.3.1.1.1 Definition

The average measured usable sensitivity expressed as field strength for analogue speech is the average of eight measurements of field strength, expressed in dBµV/m, at the *nominal frequency* of the receiver and with specified *test modulation* which produce a SINAD ratio of 20 dB measured at the receiver output through a *psophometric weighting network*, when the receiver is rotated in 45° increments starting at the reference orientation.

5.3.1.1.2 Method of measurement

A test site which fulfils the requirements of the specified frequency range of this measurement shall be used. The test antenna shall be oriented initially for vertical polarisation unless otherwise stated. (In some ETS a single polarisation for the test antenna may be specified for the measurements).

A) Method of measurement for equipment not fitted with squelch circuit.



1: SINAD meter and psophometric weighting network
2: AF load/acoustic coupler
3: Receiver under test
4: Test antenna
5: Signal generator

Figure 68: Measurement arrangement N° 1

a) A signal generator shall be connected to the **test antenna**. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by the *test modulation A-M1*. The receiver under test shall be placed on the support in its **standard position** and oriented so that a face, specified by the manufacturer, is normal to the direction of the **test antenna**. This is the reference orientation for the measurement. A distortion factor meter incorporating a 1,000 Hz *band-stop filter* (or a SINAD meter) shall be connected to the receiver output terminals via a psophometric filter and an *audio frequency load* or by an acoustic coupler for receivers not fitted with a direct connection.

b) The output level of the signal generator shall be adjusted until a *psophometrically weighted* SINAD ratio (or its acoustic equivalent) of 20 dB is obtained.

c) The **test antenna** shall be raised or lowered again through the specified height range to find the lowest level of the test signal that produces a *psophometrically weighted* SINAD ratio of (or its acoustic equivalent) of 20 dB.

d) Record the minimum signal generator level from steps b) or c).

e) Steps b) to d) above shall be repeated for the eight positions 45° apart of the receiver and the corresponding values of the generator output which produces the same *psophometrically weighted* SINAD ratio again (or its acoustic equivalent) will be determined and noted.

f) Using the calibration of the **test site**, calculate the eight field strengths X_i in µVf/m corresponding to the above output levels of the signal generator. The average measured usable sensitivity expressed as field strength X_{mean} (dBµV/m) is given by:

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

g) Steps b) to f) above shall be repeated with the **test antenna** oriented in horizontal polarisation.

h) Note the lower value of the two recorded in steps f) and g) above.

i) Using the **test fixture** in measurement arrangement N°2 the measurement may also be performed under *extreme test conditions*.

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

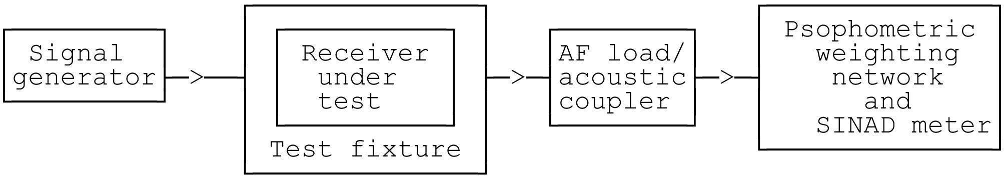
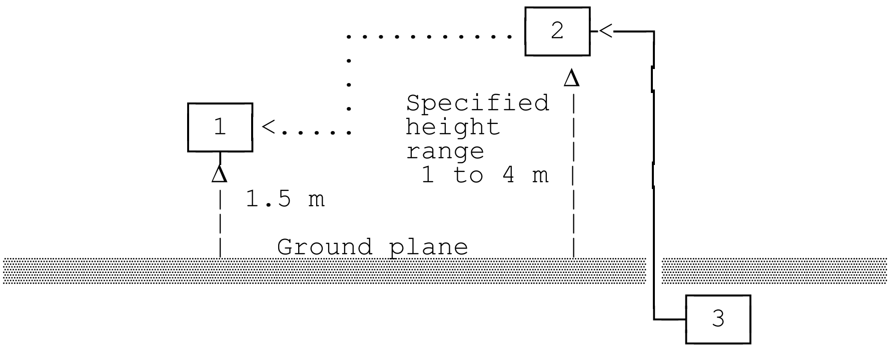


Figure 69: Measurement arrangement N°2

j) The test signal input level providing a *psophometrically weighted* SINAD ratio of 20 dB (or its acoustic equivalent) is determined under *normal and extreme test conditions* and the difference in dB is noted. This correction is algebraically added to the average measured usable sensitivity to radiated fields for analogue speech expressed in dBµV/m under *normal test conditions*, to obtain the same quantity under *extreme test conditions*.

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

B) Method of measurement for equipment fitted with a squelch circuit



1. Receiver under test
2. Test antenna
3. Signal generator

Figure 70: Measurement arrangement N°1

Due to additional uncertainties related to the squelch opening point, this method should be avoided and a specific note should be included in the test report if no better method can be used taking into account the equipment under test.

a) A signal generator shall be connected to the **test antenna**. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by the *test modulation A-M1* and if necessary with a tone for the squelch circuit. The receiver under test shall be placed on the support in its **standard position** and oriented so that a face, specified by the manufacturer, is normal to the direction of the **test antenna**. This is the reference orientation for the measurement.

b) In case of an adjustable squelch, it shall be adjusted to open using an input signal level providing a SINAD between 10 and 20 dB, as estimated by a listening test. This setting shall be retained in the following measurement procedure.

c) Having reduced the output level of the test generator to close the squelch, this level shall be increased until the squelch just opens.

d) The **test antenna** shall be raised or lowered again through the specified height range to find the lowest level of the test signal for which the squelch just opens.

e) Record the minimum signal generator level from steps c) or d).

f) Steps b) to e) above shall be repeated for the eight positions 45° apart of the receiver and the corresponding values of the generator output which just opens the squelch will be determined and noted.

g) Using the calibration of the **test site**, calculate the eight field strengths X_i(µV/m) corresponding to the output level above of the signal generator, and the average field strength X_{mean}(dBµV/m) is given by :

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

h) Measurements b) to g) above shall be repeated with the **test antenna** oriented in horizontal polarisation.

i) Record the lower value of the two recorded in steps g) and h) above.

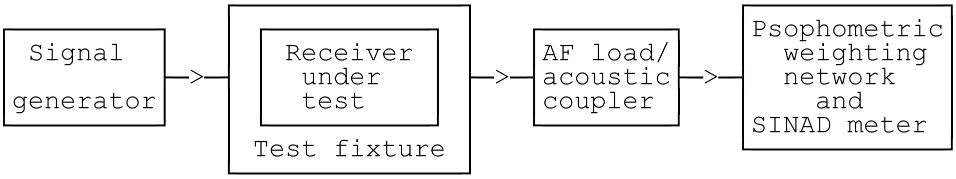


Figure 71: Measurement arrangement N°2

j) The receiver under test is now placed in a **test fixture**, and the test signal applied to it. Special attention should be paid to keep the same environmental conditions.

k) Starting from a low level, the level of the signal generator shall be increased until the squelch just opens, and the corresponding level Y (dB/µV) shall be recorded.

l) Determine the test signal level Z (dB/µV) producing a psophometrically weighted SINAD ratio of 20 dB (or its acoustic equivalent).

m) The average sensitivity to radiated field is calculate by X_{mean}+Z-Y(dBµV/m).

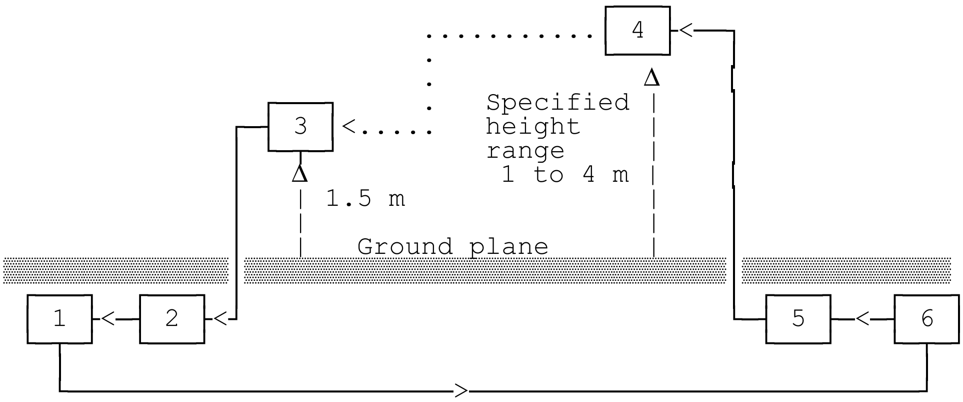
n) Using the **test fixture** in measurement arrangement N°2 the measurement may also be performed under *extreme test conditions*. In this case the assumption is made that the values X_{mean} and Y remain unchanged. Only the new value of Z will be measured, and the new value of X_{mean}+Z-Y calculated.

5.3.1.2 Average measured usable sensitivity expressed as field strength for bit stream

5.3.1.2.1 Definition

The average measured usable sensitivity expressed as field strength for bit stream is the average of eight measurements of field strength, expressed in dBµV/m, at the *nominal frequency* of the receiver and with specified *test modulation* which produces after demodulation a data signal with a bit error ratio of 10^{-2}, when the receiver is rotated in 45° increments, starting at the reference orientation.

5.3.1.2.2 Method of measurement



1. Bit error measuring test set
2. Termination
3. Receiver under test
4. Test antenna
5. Signal generator
6. Bit stream generator

Figure 72: Measurement arrangement N°1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used. The **test antenna** shall be oriented initially for vertical polarisation unless otherwise stated. (in some ETS a single polarisation for the test antenna may be specified for the measurements. In this case there is no need to proceed as in step h).

A signal generator shall be connected to the **test antenna**. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by the *test modulation D-M2*. The receiver under test shall be placed on the support in its **standard position** and oriented so that a face, specified by the manufacturer, is normal to the direction of the **test antenna**. This is the reference orientation for the measurement.

b) The bit pattern of the modulating signal shall be compared to the bit pattern obtained from the receiver after demodulation.

c) The output level of the signal generator shall be adjusted until a bit error ratio of 10^{-2} is obtained.

d) The **test antenna** shall be raised or lowered again through the specified height range to find the lowest level of the test signal which produces the same bit error ratio.

e) Record the minimum signal generator level from steps c) or d).

f) Steps b) to e) above shall be repeated for the eight positions 45° apart of the receiver and the corresponding values of the generator output which produces the same bit error ratio will be determined and recorded.

g) Using the calibration of the **test site**, calculate the eight field strengths X_i(µV/m) corresponding to the output level above of the signal generator. The average measured usable sensitivity expressed as field strength X_{mean} (dBµV/m) is given by:

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

h) Measurements b) to g) above shall be repeated with the **test antenna** oriented in horizontal polarisation.

i) Record the lower value of the two recorded in steps g) and h) above.

j) Using the **test fixture** in measuring arrangement N°2 the measurement may also be performed under *extreme test conditions*.

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

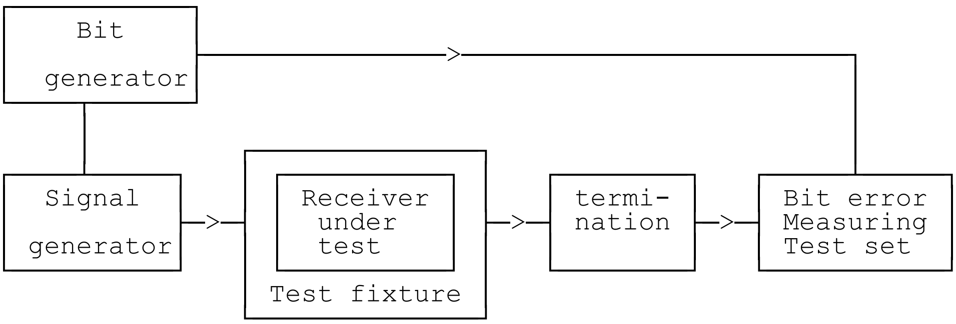


Figure 73: Measurement arrangement N°2

k) The test signal input level providing a bit error ratio of 10^{-2} is determined under *normal and extreme test conditions* and the difference in dB is noted. This difference is algebraically added to the average measured usable sensitivity to radiated fields for bit stream expressed in dBµV/m under *normal test conditions*, to obtain the same quantity under *extreme test conditions.*

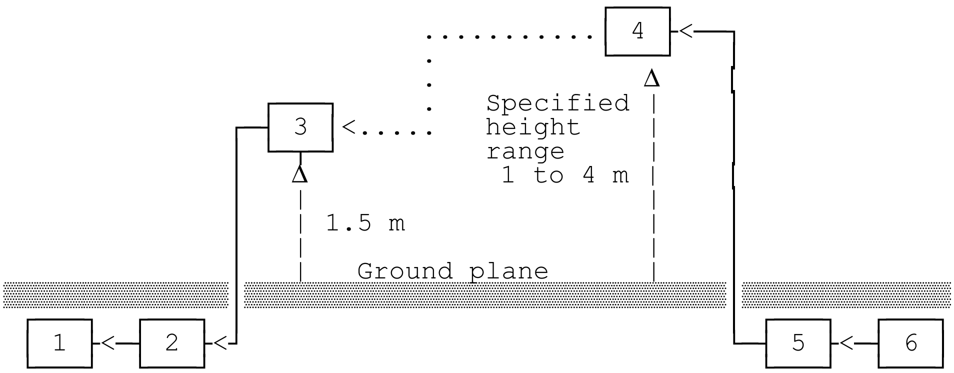
Additional uncertainties can occur under extreme test conditions due to the calibration of the test fixture.

5.3.1.3 Average measured usable sensitivity expressed as field strength for messages

5.3.1.3.1 Definition

The average measured usable sensitivity expressed as field strength for messages is the average of eight measurements of field strength, expressed in dBμV/m, at the *nominal frequency* of the receiver and with specified *test modulation* which produces after demodulation a message acceptance ratio of 80 %, when the receiver is rotated in 45° increments, starting at the reference orientation.

5.3.1.3.2 Method of measurement



1. Response measuring test set
2. Termination
3. Receiver under test
4. Test antenna
5. Signal generator
6. Message generator

Figure 74: Measurement arrangement N° 1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used. The **test antenna** shall be oriented initially for vertical polarisation unless otherwise stated. (In some ETS a single polarisation for the test antenna may be specified for the measurements. In this case there is no need to proceed as in step j).

A signal generator shall be connected to the **test antenna**. The signal generator shall be at the *nominal frequency* of the receiver and shall be modulated by the *test modulation D-M3*. The receiver under test shall be placed on the support in its **standard position** and oriented so that a face, specified by the manufacturer, is normal to the direction of the **test antenna**. This is the reference orientation for the measurement.

b) The level of the RF signal shall be such that a successful message response ratio of less than 10 % is obtained.

c) The *test signal D-M3* shall be transmitted repeatedly while 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.

d) The **test antenna** shall be raised or lowered again through the specified height range to find the lowest level of the test signal for which three consecutive successful responses are observed.

e) Record the minimum signal generator level from steps c) or d).

f) The input signal level shall be reduced by 1 dB and the new value recorded. The *test signal D-M3* 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 10 changes of level have been recorded.

g) The average of the values recorded in step e/and f) is calculated.

h) Steps b) to e) above shall be repeated for the eight positions 45° apart of the receiver and the corresponding average values of the generator output will be determined and noted.

i) Using the calibration of the **test site**, calculate the eight field strengths X_i (µV/m) corresponding to the eight average values determined in step h). The average measure usable sensitivity expressed as field strength X_{mean} (dBµV/m) is given by:

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

j) Measurements b) to i) above shall be repeated with the **test antenna** oriented in horizontal polarisation.

k) Note the lower value of the two recorded in steps i) and j) above.

l) Using the **test fixture** in measurement arrangement N°2 the measurement may also be performed under *extreme test conditions*.

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

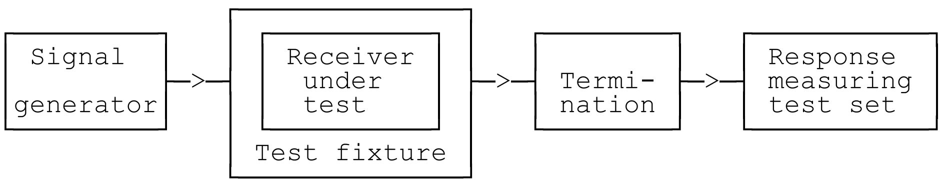


Figure 75: Measurement arrangement N°2

m) The test signal input level providing a message acceptance ratio of 80 % is determined under *normal and extreme test conditions* and the difference in dB is noted. This difference is algebraically added to the average measured usable sensitivity to radiated fields for messages expressed in dBµV/m under *normal test conditions*, to obtain the same quantity under *extreme test conditions.*

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

5.3.2 Maximum measured usable sensitivity expressed as field strength

5.3.2.1 Maximum measured usable sensitivity expressed as field strength for analogue speech

5.3.2.1.1 Definition

The maximum measured usable sensitivity expressed as field strength for analogue speech is the minimum measurement of field strength, expressed in dBµV/m, at the *nominal frequency* of the receiver and with specified *test modulation* which produce a SINAD ratio of 20 dB measured at the receiver output through a *psophometric weighting network*, when the receiver is rotated through 360° in the horizontal plane.

5.3.2.1.2 Method of measurement

The method of measurement described in paragraph 5.3.1.1 is repeated with the difference that instead of rotating the receiver in 45° increments, measurements are taken while the receiver is continuously rotated through 360° in the horizontal plane. The lowest level of the test signal which produces an SINAD ratio of 20 dB (or its acoustic equivalent) is recorded. Using the calibration of the **test site** calculate the field strength. This $X_{maximum}$ is recorded and used instead of X_{mean}.

5.3.2.2 Maximum measured usable sensitivity expressed as field strength for bit stream

The maximum measured usable sensitivity expressed as field strength for bit stream is the minimum of eight measurements of field strength, expressed in dBµV/m, at the *nominal frequency* of the receiver and with specified *test modulation* which produces after demodulation a data signal with a bit error ratio of 10^{-2}, when the receiver is rotated in 45° increments, starting at the reference orientation.

5.3.2.2.1 Method of measurement

The method of measurement described in paragraph 5.3.1.2 is repeated. The minimum value of the generator output of the sixteen measurements taken both with vertical and horizontal polarization in step f) is recorded. Using the calibration of the **test site**, calculate the field strength (dBµV/m) corresponding to the output level of the signal generator. This is the maximum measured usable sensitivity expressed as field strength for bit stream.

5.3.2.3 Maximum measured usable sensitivity expressed as field strength for messages

5.3.2.3.1 Definition

The maximum measured usable sensitivity expressed as field strength for messages is the minimum of eight measurements of field strength, expressed in dBµV/m, at the *nominal frequency* of the receiver and with specified *test modulation* which produces after demodulation a message acceptance ratio of 80 %, when the receiver is rotated in 45°increments, starting at the reference orientation.

5.3.2.3.2 Method of measurement

The method of measurement described in paragraph 5.3.1.3 is repeated. The minimum value of the generator output of the sixteen measurements taken both with vertical and horizontal polarization in step h) is recorded. Using the calibration of the **test site**, calculate the field strength (dBµV/m) corresponding to the output level of the signal generator. This is the maximum measured usable sensitivity expressed as field strength for messages.

5.3.3 Radiated spurious components

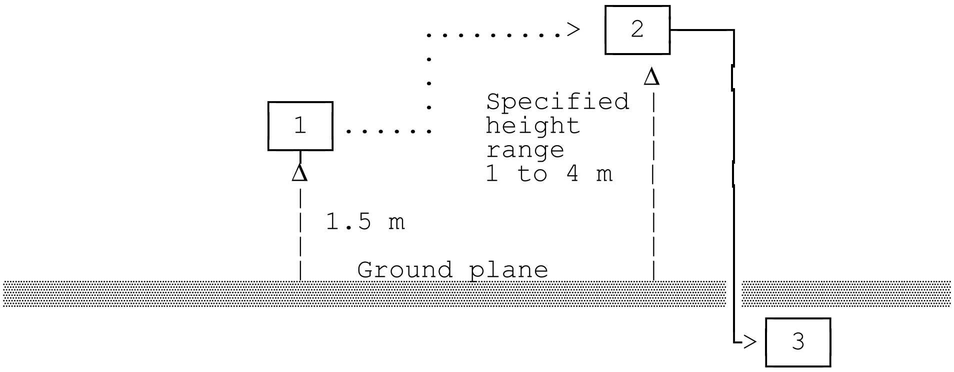
5.3.3.1 Definition

Radiated spurious components are emissions radiated by the antenna and the cabinet of the receiver.

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

5.3.3.2 Method of measurement

This method of measurement applies to receivers having an integral antenna.



1. Receiver under test
2. Test antenna
3. Spectrum analyser or selective voltmeter

Figure 76: Measurement arrangement N°1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used.The **test antenna** shall be oriented for vertical polarisation and connected to a spectrum analyser or a selective voltmeter. The bandwidth of the spectrum analyser or selective voltmeter shall be between 10 and 100 kHz.

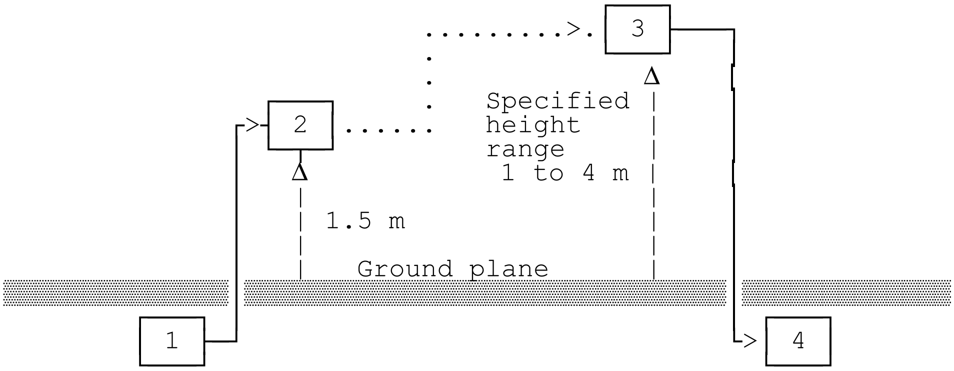
   The receiver under test shall be placed on the support in its **standard position**.

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

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

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

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



1. Signal generator.
2. Substitution antenna
3. Test antenna
4. Spectrum analyser or selective voltmeter

Figure 77: Measurement arrangement N°2

f) Using measurement arrangement N°2 the **substitution antenna** shall replace the receiver antenna in the same position and in vertical polarisation. It shall be connected to the signal generator.

g) For each frequency at which a component has been detected, the signal generator and spectrum analyser or selective voltmeter shall be tuned and the **test antenna** shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter. The level of the signal generator giving the same signal level on the spectrum analyser or selective voltmeter as in item e) above shall be recorded. This value, after correction due to the gain of the **substitution antenna** and the cable loss between the signal generator and the **substitution antenna,** is the radiated spurious component at this frequency.

h) Measurements b) to g) above shall be repeated with the **test antenna** oriented in horizontal polarisation.

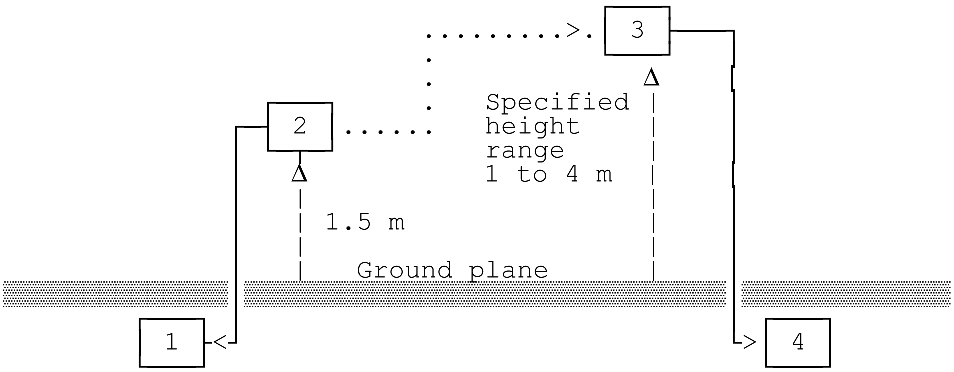
5.3.4 Cabinet radiation

5.3.4.1 Definition

Cabinet radiation is radiation coming from the cabinet of the receiver. It is specified as the radiated power of any discrete signal.

5.3.4.2 Method of measurement

This method of measurement applies to receivers having an antenna socket.



1. Test load
2. Receiver under test
3. Test antenna
4. Spectrum analyser or selective voltmeter

Figure 78: Measurement arrangement N°1

a) A **test site** which fulfils the requirements of the specified frequency range of this measurement shall be used.The **test antenna** shall be oriented for vertical polarisation and connected to a spectrum analyzer or selective voltmeter. The bandwidth of the spectrum analyser or selective voltmeter shall be between 10 and 100 kHz.

The receiver under test shall be placed on the support in its **standard position** and connected to a *test load.*

b) The same method of measurement as items b) to h) of 5.3.3 "Radiated spurious components" will apply.

5.3.5 Spurious response immunity to radiated fields

5.3.5.1 Spurious response immunity to radiated fields for analogue speech

5.3.5.1.1 Definition

The spurious response immunity to radiated fields for analogue speech is the measure of the capability of the receiver to discriminate between the wanted modulated radiated field at the nominal frequency and an unwanted radiated field at any other frequency at which a response is obtained.

It is specified as the ratio, in decibels, of an unwanted signal level expressed as field strength to a specified wanted signal level expressed as field strength producing, through a *psophometric weighting network*, a SINAD ratio of 14 dB.

5.3.5.1.2 Method of measurement

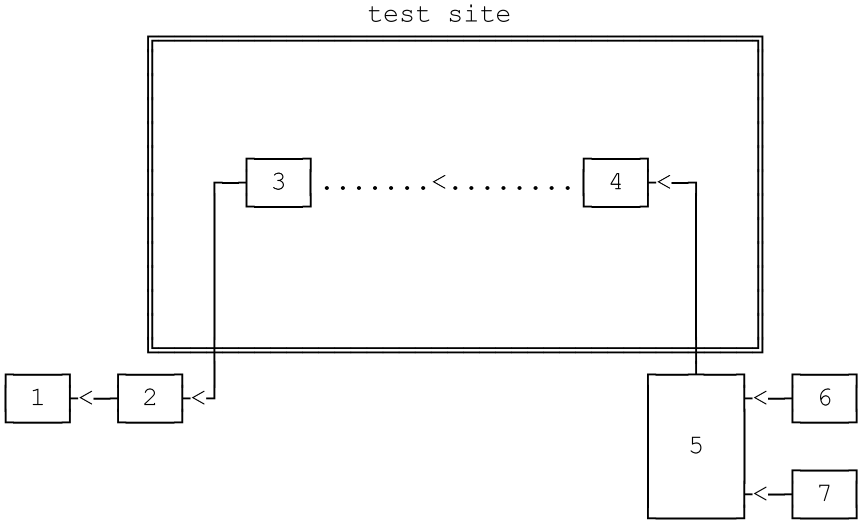


Figure 79: Measurement arrangement

1. Psophometric weighting network and SINAD meter
2. AF load/acoustic coupler
3. Receiver under test
4. Wide band test antenna
5. Combining network
6. Signal generator A
7. Signal generator B

It is strongly recommended to use an **anechoic chamber** or a **stripline arrangement** in preference to an **open air test site** for two main reasons :

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

- In the presence of the ground plane the antenna height has to be altered to optimise the reflections from the ground plane. This cannot be done simultaneously for two different frequencies.

a) Two signal generators A and B shall be connected via a *combining network* to the wide band **test antenna** or to the input terminal of the **stripline arrangement**. The wanted signal, represented by signal generator A, shall be at the *nominal frequency* of the receiver and shall have *test modulation A-M1*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3*.

   The receiver under test shall be placed in its **standard position** on the support in the **anechoic chamber** or in the **stripline arrangement**.

b) Initially the unwanted signal shall be switched off and the amplitude of signal generator A shall be adjusted to the *wanted signal level* expressed in field strength when measured at the receiver input.

   Where the frequency of the wanted signal is outside the calibrated bandwidth of the wideband **test antenna** a suitable correction factor shall be applied.

c) The unwanted signal shall then be switched on and its level shall be adjusted to give a field strength which is 80 db in excess of the wanted signal level, when measured at the receiver input. The frequency of the unwanted signal shall then be varied over the specified *limited frequency range* plus 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.

d) At any frequency at which a response occurs, the input level of the unwanted signal shall be adjusted until a SINAD ratio of 14 dB (or its acoustic equivalent) through a *psophometric weighting network* is obtained.

e) The spurious response immunity ratio to radiated fields for analogue speech shall be expressed, for the frequency concerned, as the ratio in dB of the field strength of the unwanted and the wanted signals at the receiver input.

5.3.5.2 Spurious response immunity to radiated fields for bit stream

5.3.5.2.1 Definition

The spurious response immunity to radiated fields for bit stream is the measure of the capability of the receiver to discriminate between the wanted modulated radiated field at the nominal frequency and an unwanted radiated field at any other frequency at which a response is obtained.

It is specified as the ratio, in decibels, of an unwanted signal level expressed as field strength to a specified wanted signal level expressed as field strength producing a data signal with a bit error ratio of 10^{-2}.

5.3.5.2.2 Method of measurement

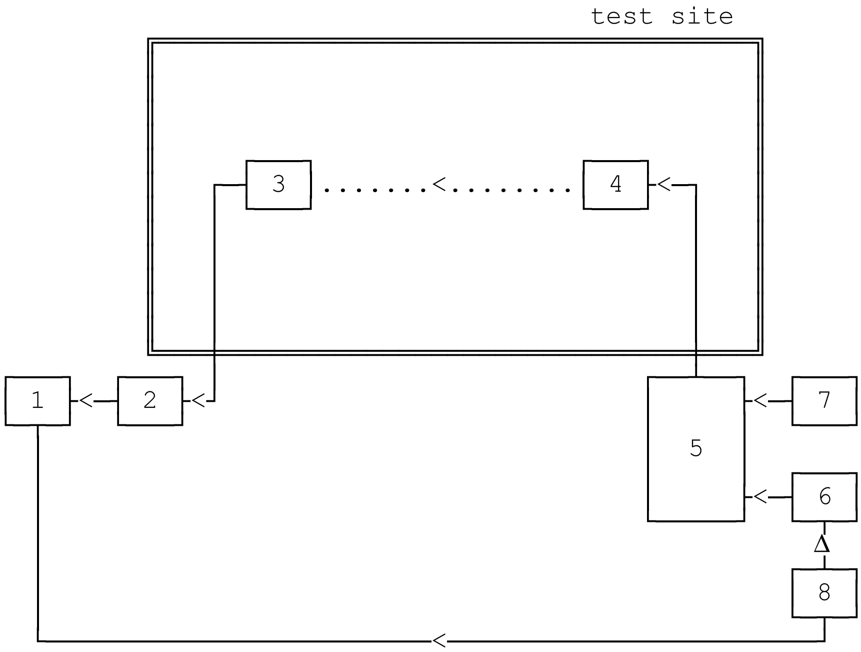


Figure 80: Measurement arrangement

1. Bit error measuring test set
2. Termination
3. Receiver under test
4. Wide band test antenna
5. Combining network
6. Signal generator A
7. Signal generator B
8. Bit stream generator

It is strongly recommended to use an **anechoic chamber** or a **stripline arrangement** in preference to an **open air test site** for two main reasons :

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

- In the presence of the ground plane the antenna height has to be altered to optimise the reflections from the ground plane. This cannot be done simultaneously for two different frequencies.

a) Two signal generators A and B shall be connected via a *combining network* to the wide band **test antenna** or to the input terminal of the **stripline arrangement**. The wanted signal, represented by signal generator A, shall be at the *nominal frequency* of the receiver and shall have *test modulation D-M2*. The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur. The receiver under test shall be placed in its **standard position** on the support in the **anechoic chamber** or in the **stripline arrangement**.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* expressed as field strength when measured at the receiver input. Where the frequency of the wanted signal is outside the calibrated bandwidth of the wideband **test antenna** a suitable correction factor shall be applied.

c) The unwanted signal shall then be switched on, and the input level adjusted until a bit error ratio of about 10^{-1} is obtained.

d) The wanted signal shall then be transmitted whilst observing the bit error ratio. The level of the unwanted signal shall be reduced in steps of 1 dB until a bit error ratio of 10^{-2} or better is obtained. The level of the unwanted signal shall then be recorded.

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

f) The spurious response immunity to radiated fields for bit stream shall be expressed for the frequency concerned as the ratio in dB of the field strength of the level of the unwanted signal recorded in steps d) and e) to the wanted signal at the receiver input.

5.3.5.3 Spurious response immunity to radiated fields for messages

5.3.5.3.1 Definition

The spurious response immunity to radiated fields for messages is the measure of the capability of the receiver to discriminate between the wanted modulated radiated field at the nominal frequency and an unwanted radiated field at any other frequency at which a response is obtained.

It is specified as the ratio, in decibels, of an unwanted signal level expressed as field strength to a specified wanted signal level expressed as field strength producing after demodulation a message acceptance ratio of 80 %.

5.3.5.3.2 Method of measurement

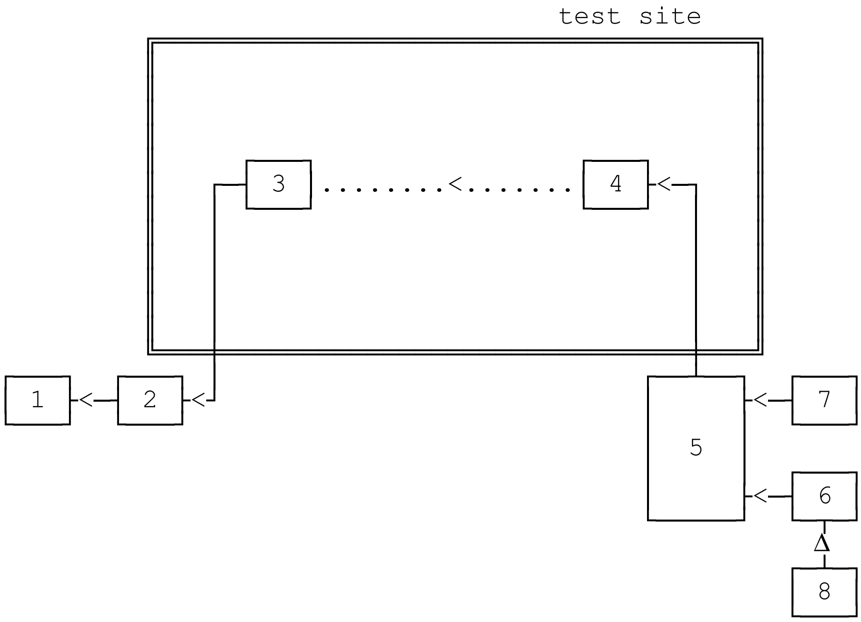


Figure 81: Measurement arrangement

1. Response measuring test set
2. Termination
3. Receiver under test
4. Wide band test antenna
5. Combining network
6. Signal generator A
7. Signal generator B
8. Message generator

It is strongly recommended to use an anechoic chamber or a stripline arrangement in preference to an open air test site for two main reasons :

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

- In the presence of the ground plane the antenna height has to be altered to optimise the reflections from the ground plane. This cannot be done simultaneously for two different frequencies.

a) Two signal generators, A and B shall be connected via a *combining network* to the wide band **test antenna** or to the input terminal of the **stripline arrangement**. The wanted signal, represented by signal generator A, shall be at the *nominal frequency* of the receiver and shall have *test modulation D-M3.* The unwanted signal, represented by signal generator B, shall have *test modulation A-M3* and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur. The receiver under test shall be placed in its **standard position** on the support in the **anechoic chamber** or in the **stripline arrangement**.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the *wanted signal level* expressed as field strength when measured at the receiver input. Where the frequency of the wanted signal is outside the calibrated bandwidth of the wideband **test antenna** suitable correction factor shall be applied.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) 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 recorded.

e) 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 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 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.

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

g) The spurious response immunity to radiated fields for messages shall be expressed for the frequency concerned as the ratio in dB of the field strength of the average of the levels of the unwanted signal recorded in steps d) and e) to the level of the wanted signal at the receiver input.

Annex A (informative):

References:

[1] IEC Publication 489-3 Second edition (1988) Appendix F pages 130 to 133.

[2] IEC Publication 489-3 Second edition (1988) Appendix J pages 156 to 164.

[3] Construction of a Stripline.
Technical Report FTZ N° 512 TB 9.

[4] Construction of a Anechoic Chamber.
Technical Report ZVEI AK-R 90/20.

History

Document history	
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