## Recommendation T/R 24-03 (Cannes 1983, revised in Copenhagen 1987)

# RADIO CHARACTERISTICS OF CORDLESS TELEPHONES

Recommendation proposed by the "Radiocommunications" Working Group T/WG 3 (R)

*Text of the Recommendation adopted by the "Telecommunications" Commission:*
"The European Conference of Postal and Telecommunications Administrations,

*considering*
(a) that there is an increasing interest by the public in using cordless telephones,
(b) that the use of such equipment can cause problems for Administrations,
(c) that harmonisation-on the broadest possible basis-of the radiotechnical parameters for cordless telephones is highly desirable,
(d) that it would be advantageous for the Administrations, the users and the manufacturers of cordless telephones to proceed to
the exchange between Administrations of the reports on tests in accordance with Recommendation T/R 71-02,
(e) that the object aimed at should be the mutual recognition, by the member Administration of the CEPT, of such test reports,

*noting*
that Recommendation T/SF 30 deals with the requirements of the user and operational characteristics and Recommendation T/CS 34-18 deals with the switching and signalling requirements,

*recommends*
1. that the cordless telephones operating in the paired bands 914-915 MHz and 959-960 MHz shall meet the radiotechnical specifications given in the Annex I of the present Recommendation,
2. that the methods of measurement, used to ascertain that the cordless telephones meet the requirements, shall be in conformity with those mentioned in the Annex I of the present Recommendation,
3. that, in drawing up the test reports, the Administration shall, as much as possible, follow the order of the tests and the numbering of the paragraphs used in the Annex I to the present Recommendation."

# Annex I

## Technical characteristics, test conditions and methods of measurement for radio aspects of cordless telephones, operating in the paired bands 914-915 MHz and 959-960 MHz

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# 1. DEFINITION, PRINCIPLES OF OPERATION AND GENERAL REQUIREMENTS

## 1.1. Definition

A cordless telephone is a telephone terminal connected to an exchange line or an extension line and is integrated with or accompanied by a normal telephone set.
It consists of two parts, which are connected by a radio link:
- a fixed part
- a portable part permitting the same basic functions as a normal telephone set within a limited area around the fixed part.

A cordless telephone may be either:
(a) a fully functional cordless telephone, on which calls can be set tip and answered by the portable part; or
(b) a limited cordless telephone where the portable part has no facility for initiating outgoing calls

Facilities for answering calls without using a radio link shall be provided

## 1.2. Procedure to set up the r.f. - connection between fixed and portable part

Occupancy of a radio frequency channel may be initiated by the fixed part, or the portable part, if suitably equipped, by following the same procedure. Both fixed and portable parts comprise a transmitter and a receiver which will perform full duplex operation.
When the need for a radio frequency channel arises in any of the two parts of a cordless telephone set, this part will act in general as follows:
(a) the initiating part searches for an idle duplex channel. A channel is considered to be idle if the initiating part of the cordless telephone senses that the radio frequency fieldstrength on that specific channel is below a specified limit;
(b) on the idel (duplex) channel, found under (a), the initiating part starts transmitting signals to the other part of the same cordless telephone set. These signals contain an identification code, which offers at least 999.999 different combinations;
(c) the receiver of each part of a cordless telephone set is constantly scanning, searching for a signal which contains its matching identification code.
Upon detection of this code, the receiver stops scanning and initiates its transmitter to occupy the corresponding return frequency of the duplex pair and to transmit its identification code to the initiating part;
(d) as soon as the receiver of the initiating part detects its matching identification code on the return frequency of the selected duplex channel, the initiating transmitter stops transmitting identification signals;
(e) the duplex channel becomes available for the transmission of dialling tones and speech.

1.3. **Operating**

Cordless telephones shall be constructed to use all of the following duplex frequencies.

| Transmitting frequencies | | Channel number |
|---|---|---|
| Portable part | Fixed part | |
| 914.0125 MHz | 959.0125 MHz | 1 |
| 914.0375 MHz | 959.0375 MHz | 2 |
| 914.0625 MHz | 959.0625 MHz | 3 |
| 914.0875 MHz | 959.0875 MHz | 4 |
| 914.1125 MHz | 959.1125 MHz | 5 |
| 914.1375 MHz | 959.1375 MHz | 6 |
| 914.1625 MHz | 959.1625 MHz | 7 |
| 914.1875 MHz | 959.1875 MHz | 8 |
| 914.2125 MHz | 959.2125 MHz | 9 |
| 914.2375 MHz | 959.2375 MHz | 10 |
| 914.2625 MHz | 959.2625 MHz | 11 |
| 914.2875 MHz | 959.2875 MHz | 12 |
| 914.3125 MHz | 959.3125 MHz | 13 |
| 914.3375 MHz | 959.3375 MHz | 14 |
| 914.3625 MHz | 959.3625 MHz | 15 |
| 914.3875 MHz | 959.3875 MHz | 16 |
| 914.4125 MHz | 959.4125 MHz | 17 |
| 914.4375 MHz | 959.4375 MHz | 18 |
| 914.4625 MHz | 959.4625 MHz | 19 |
| 914.4875 MHz | 959.4875 MHz | 20 |
| 914.5125 MHz | 959.5125 MHz | 21 |
| 914.5375 MHz | 959.5375 MHz | 22 |
| 914.5625 MHz | 959.5625 MHz | 23 |
| 914.5875 MHz | 959.5875 MHz | 24 |
| 914.6125 MHz | 959.6125 MHz | 25 |
| 914.6375 MHz | 959.6375 MHz | 26 |
| 914.6625 MHz | 959.6625 MHz | 27 |
| 914.6875 MHz | 959.6875 MHz | 28 |
| 914.7125 MHz | 959.7125 MHz | 29 |
| 914.7375 MHz | 959.7375 MHz | 30 |
| 914.7625 MHz | 959.7625 MHz | 31 |
| 914.7875 MHz | 959.7875 MHz | 32 |
| 914.8125 MHz | 959.8125 MHz | 33 |
| 914.8375 MHz | 959.8375 MHz | 34 |
| 914.8625 MHz | 959.8625 MHz | 35 |
| 914.8875 MHz | 959.8875 MHz | 36 |
| 914.9125 MHz | 959.9125 MHz | 37 |
| 914.9375 MHz | 959.9375 MHz | 38 |
| 914.9625 MHz | 959.9625 MHz | 39 |
| 914.9875 MHz | 959.9875 MHz | 40 |

The channel separation is 25 kHz.
The duplex distance is 45 MHz.
The frequency band 914-915 MHz shall be used by the transmitter of the portable part.

1.4. **General requirements**

The performance of a cordless telephone shall be such that its interaction with the public switched telephone network shall be as near as possible to that of a normal telephone.

1.4.1. *Modulation*
Only frequency or phase modulation (F3E or G3E) shall be used.

1.4.2. *Antenna*

The equipment shall be constructed such as to function only by means of an integral antenna. The use of an external removable antenna shall be excluded in the design and construction of the equipment.
In this specification, an integral antenna is defined as one, which is designed to be connected permanently to the transmitter/ receiver without the use of a connector and/or the use of a feeder.
Only the use of an omnidirectional antenna shall be allowed.

1.4.3. *Compending*

To improve the signal to noise ratio and the subjective quality it is suggested that syllabic compression and expanding of the audio signal in accordance with CCITT Recommendation G.162 be incorporated or that a speech controlled amplifier at the audio input of the base stations be used. In the latter case the time constant should be less than 10 milliseconds for amplification reduction and between 100 milliseconds and 1 second for regaining full amplification.

1.4.4. *Threshold level for R.F.-sensing and minimum observation time*

To determine the availability of a channel during the scanning procedure both parts of a cordless telephone set shall be equipped with an R.F.-level detector, which provides an R.F.-sensing facility. A channel shall be considered as "not in use" if the median level of the fieldstrength is lower than 20 dB relative to 1 microvolt per metre.
The minimum observation time before a channel is considered to be available shall be 100 milliseconds. The maximum observation time of occupied channels not loaded by a datasignal shall not exceed 30 milliseconds per channel.

1.4.5. *Scanning time*

In case of an incoming ringing voltage from the telephone line, the scanning procedure shall start within one second after detection of the ringing signal.
When a call is initiated from the portable part, the scanning procedure shall start immediately.
When a channel is available, the time between initiating a connection and seizure of the channel shall be no more than 5 seconds.
When a free channel is located the initiating part shall transmit identification signals for no longer than 3 seconds. If the opposite part has not responded after 3 seconds, the initiating part recommences searching for another free channel.
In the case of an incoming call this procedure continues as long as there is a ringing tone.
In the case of an outgoing call from the portable part and when no channel is seized within 5 seconds a local busy tone shall appear for at least *3* seconds

1.4.6. *Use of the identification code*

1.4.6.1. General

In the procedure to set up the RF connection between the fixed part and the portable part, the initiating part shall transmit a unique identification code until an answer from the opposite part containing the same unique identification code is received (see Clauses 1.2. and 1.4.5.). The exchange of identification codes shall ensure that only associated parts will lock to each other.

1.4.6.2. The exchange of the code

The identification code shall also be transmitted with every signalling information transmitted over the radio channel from the portable part, which is intended for the telephone line.
Signalling information shall only be forwarded to the telephone line if the identification code, which was received, matches to the identification code of the fixed part.
As an alternative to the above, the identification code shall be used to ensure that only the associated fixed and portable parts will lock to each other.
To ensure continued locking during a call this identification procedure shall be exchanged between the fixed and the portable part and be repeated at intervals no longer than *45* seconds.
This may be achieved by audible signalling during the conversation or preferably by inaudible out-of-band signalling.

1.4.6.3. The number of codes and their protection

The number of code combinations shall be at least 999.999. Protection against unauthorised changes of the code shall be incorporated. Administrations may coordinate the assignment of codes.

1.4.6.4. Wrong identification codes

If wrong identification codes are received twice, the RF-connection shall be terminated (see Clause 1.4.8.).

1.4.7. *Answering incoming calls*
When an incoming call is answered by means of the portable part, it shall transmit a coded answer signal, including the identification code. On receipt of this signal the fixed part shall create the appropriate line condition.

1.4.8. *Termination of the R.F.-connection crud line connection*
After termination of the R.F.-connection in accordance with points 1.4.8.1. to 1.4.8.3. the telephone line loop connection should be immediately released, unless the conversation has been taken over by the fixed part.

1.4.8.1. Termination of the R.F.-connection
When the R.F.-connection is to be terminated, the part of the cordless telephone set which initiates the termination shall transmit 4 times a coded termination message, including the identification code, which would be used for initiating a R.F. -connection. The R.F. circuit shall then be disconnected and the cordless telephone set shall return to the idle condition.

1.4.8.2. Time limitation on channel occupancy
To prevent unintended occupation of a radio channel the equipment shall automatically terminate a connection after 10 to 15 minutes by cutting the radio link. Termination shall be preceded by a warning signal. A facility for the subscriber to cancel this termination may be provided.

1.4.8.3. Interruption of a connection due to low fieldstrength
The portable part of the cordless telephone is considered to be "out of range" if the median level of the fieldstrength at the receiving part is less than 30 dB relative to one microvolt per metre, in which case the portable part shall produce a warning signal after 0.5 ± 0.1 second. The line connection and R.F. circuit in use by the cordless telephone set shall be terminated automatically if the portable part of the cordless telephone has remained "out of range" for more than 10 ± 1 sec.

1.4.9. *Co-operation with the normal telephone set*

1.4.9.1. Incoming calls
Incoming calls shall initially activate the normal telephone set and the fixed part of the cordless telephone. If this incoming call is answered by the normal telephone set any action by the cordless telephone shall cease. When the call is answered by the portable part, an indication shall appear on the fixed part.
If the portable part is in the rest position (that is, attached to the fixed unit), the search procedure for free radio frequency channels shall be inhibited.

1.4.9.2. Outgoing calls
An outgoing call, initiated by the portable part, shall be indicated on the fixed part.
When an outgoing call is initiated by the associated normal telephone set, the cordless telephone shall be disabled. In this case, an attempt to initiate a call from the portable part shall be answered by the fixed part with a message, which may result in a local busy tone, which shall be maintained as long as the handset of the normal telephone is lifted.

1.4.9.3. Intercommunication function
There shall be no facilities to realise intercommunication between the fixed part or accompaying telephone set and the portable part of the cordless telephone apart from the possibility described in section 1.4.9.4.

1.4.9.4. Handover from the cordless telephone to the normal telephone and vice versa
When the handset of the normal telephone is lifted during a conversation via the portable part, the conversation is then taken over by the normal telephone. If the portable part is switched on after a call has been answered or initiated by the normal telephone, the scanning time and identification procedures (1.4.4. and 1.4.6.) shall be followed by an indication at the fixed part. The fixed part shall answer with a message, which may result in a local busy tone at the portable part (1.4.9.2.). If after this, the normal telephone is replaced, the conversation shall be taken over by the portable part.
For incoming calls the possibility of conversation between the fixed part and the portable part may be allowed for a maximum of 60 seconds during the conversation.
In order to change purposely from the portable part to the fixed part or vice versa it shall be possible to cause an indication in the opposite part that a transfer of conversation is desired.

1.4.10. *Power supply for tire portable part*

The supply voltage is considered to be insufficient if it is lower than the lowest voltage, which is mentioned under "extreme test voltages" for the applicable type of power source.
If the supply voltage is insufficient it shall not be possible to establish an R.F.-connection. Means shall be provided to indicate the supply voltage situation on the portable part.

1.4.11. *Power supply the fixed part*

The power supply for the fixed part shall not be taken from the public switched telephone network.

## 2. TEST CONDITIONS, POWER SOURCES AND AMBIENT TEMPERATURES

### 2.1. Normal and extreme test conditions

Type approval tests shall be made under normal test conditions, and also, where stated, under extreme test conditions.
The test conditions and procedures shall be as specified in Clauses 2.2. to 2.5.

### 2.2. Test power source

During type approval tests the power source of the equipment shall be replaced by a test power source, capable of producing normal and extreme test voltages as specified in Clauses 2.3.2. and 2.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.
If the equipment is provided with a permanently connected power cable, the test voltage shall be that measured at the point of connection of the power cable to the equipment.
In equipment with incorporated batteries the test power source shall be applied as close to the battery terminals as practicable.
During tests, the power source voltages shall be maintained within a tolerance of ± 3% relative to the voltage at the beginning of each test.

### 2.3. Normal test conditions

2.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:
Temperature: + 15° C to +35° C
Relative humidity: 20% to 75%
*Note.* When it is impracticable to carry out the tests under the conditions stated above, a note to this effect, stating the actual temperature and relative humidity during the tests, shall be added to the test report.

2.3.2. *Normal test power source*

2.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.
The frequency of the test power source shall be an AC-frequency between 49 and 51 Hz.

2.3.2.2. Other power sources

For operation from other sources or types of battery (primary or secondary), the normal test voltage shall be that declared by the equipment manufacturer and agreed by the testing authority.

### 2.4. Extreme test conditions

2.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in Clause 2.5., at the following upper and lower temperatures:
0° C to +55° C

2.4.2. *Extreme test voltages*

2.4.2.1. Mains voltage and frequency
The extreme test voltage for equipment to be connected to an AC mains source shall be the nominal mains voltage + 10% and -15%. The frequency shall be an AC - frequency between 49 and 51 Hz.

2.4.2.2. Other power sources
1. For the lead-acid type of battery;
   0.9 times the nominal voltage of the battery;
2. for the Leclanché-type of battery:
   0.85 times the nominal voltage of the battery;
3. for the mercury-type of battery:
   0.9 times the nominal voltage of the battery;
4. for other types of primary batteries:
   end point voltage declared by the equipment manufacturer.

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those agreed between the equipment manufacturer and the testing authority and shall be recorded with the results.

2.5. **Procedure for tests at extreme temperatures**

2.5.1. Test procedure
Before measurements are made the equipment shall have reached thermal balance to the test chamber. The equipment shall be switched off during the temperature stabilising period[1]). If the thermal balance is not checked by measurements, a temperature stabilising period of at least one hour, or such period as may be decided by the testing authority, shall be allowed. The sequence of measurements shall be chosen, and the humidity contents in the test chamber shall be controlled so that excessive condensation does not occur.
Before tests at the upper temperatures the equipment shall be placed in the test chamber until thermal balance [1]) is attained. The equipment shall then be switched on for one minute in the transmit condition, followed by four minutes in the receive condition, after which the equipment shall meet the specified requirements. For tests at the lower temperatures the equipment shall be left in the test chamber until thermal balance[1]) is attained, then switched to the stand-by or receive condition for one minute after which the equipment shall meet the specified requirements.

## 3. GENERAL CONDITIONS

### 3.1. Arrangements for test signals applied to the receiver via a test fixture or a test antenna

Sources of test signals for application to the receiver via a test fixture (Clause 3.7.) or a test antenna (Clause 3.8.) shall be connected in such a way that the impedance presented to the test fixture or the test antenna is 50 ohms.
This requirement shall be met irrespective of whether one or more signals are applied to the receiver simultaneously.
The effects of any intermodulation products and noise produced in the signal generators should be negligible.

### 3.2. Receiver circuitry

3.2.1. *Receiver mute or squelch circuit*
The receiver mute or squelch circuit shall be made inoperative for the duration of the type approval tests.

[1]) In the case of equipment containing temperature stabilisation circuits designed to operate continuously, the temperature stabilisation circuits may be switched on for I S minutes after thermal balance has been obtained and the equipment shall then meet the specified requirements.

3.2.2. *Expander*
For the purpose of making measurements according to the specifications, an eventually available expander should be made inoperative or its amplification be set to a fixed level.

3.3. **Receiver rated audio output power**
The rated audio output power shall be the maximum power, declared by the manufacturer, for which all the requirements of this specification are met. With normal test modulation (Clause 3.4.) the audio output power shall be measured in a resistive load, simulating the load with which the receiver normally operates. The value of this load shall be:
- in the case of receiver measurements on the portable part: as declared by the manufacturer;
- in the case of receiver measurements on the fixed part: 600 ohms

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

3.5. **Encoder for receiver measurements**
To facilitate measurements on the receiver, an encoder for the signalling system should accompany the model submitted, complete with details of the normal modulation process. The encoder will be used to modulate a signal generator for use as a test signal source.
If possible, the encoder should be capable of operation in a repetitive mode, with intervals between each code that are not less than the reset time of the receiver.
Complete details of all codes and code format(s) shall be given.

3.6. **Normal coded test signal**
The normal coded test signals shall be trains of correctly coded signals, separated from each other by a time of not less than the reset time of the receiver. This signal shall be that, as agreed between the manufacturer and testing authority, which requires the greatest radio frequency occupied bandwidth. Details of this test signal shall be included in the test report.
The encoder, which is associated with the transmitter, shall be capable of supplying the normal coded test signal. If possible this should be continuous modulation for the duration of the measurements.

3.7. **Test fixture**
The manufacturer may be required to supply a test fixture suitable to allow relative measurements to be made on the submitted sample.
The testing authority may provide its own test fixture.
A test fixture shall provide a 50 ohms radio frequency terminal at the working frequencies of the equipment to the measuring instruments.
A 50 ohms connector temporarily replacing the antenna might serve as a test fixture. For RF-coupling the test fixture could also be a whip antenna with an attenuator, which are positioned close to the antenna of the equipment under test.
The test fixture shall also provide means of making external connections to the audio frequency input and output and of replacing the power source by external power supplies.
The performance characteristics of this test fixture under normal and extreme conditions are subject to the approval of the testing authority.
The characteristics of interest to the testing authority will be that:
(a) the coupling loss shall not be excessive, that is, not greater than 30 dB;
(b) the variation of coupling loss with frequency shall not cause errors exceeding *2* dB in measurements using the test fixture;
(c) the coupling device shall not include any non-linear elements.

## 3.8. Test site and general arrangements for measurements involving the use of radiated fields

### 3.8.1. *Test .site*

The test site shall be on a reasonably level surface or ground.
At one point on the site, a ground plane of at least 5 metres diameter shall be provided. In the middle of this ground plane, a non-conducting support, capable of rotation through 360° in the horizontal plane, shall be used to support the test sample at 1.5 metres above the ground plane.
The test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of at least 3 metres.
The distance actually used shall be recorded with the results of the test carried out on the site.
Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site and ground reflections do not degrade the measurement results.
A guidance on the use of radiation test sites is given in Appendix A.

### 3.8.2. *Test antenna*

The test antenna is used to detect the radiation from both the test sample and the substitution antenna, when the site is used for radiation measurements: where necessary, it is used as a transmitting antenna, when the site is used for the measurement of receiver characteristics. This antenna is mounted on a support such as to allow the antenna to be used in either the horizontal or vertical polarisation and for the height of its centre above ground to be varied over the range 1-4 metres. Preferably test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20% of the measuring distance.
For radiation measurements, the test antenna is connected to a test receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input. When necessary (for receiver measurements) the test receiver is replaced by a signal source.

### 3.8.3. *Substitution antenna*

The substitution antenna shall be a λ./2 dipole, resonant at the frequency under consideration, or a shortened dipole, calibrated to the λ,/2 dipole. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an external antenna is connected to the cabinet.
The distance between the lower extremity of the dipole and the ground shall be at least 30 cm.
The substitution antenna shall be connected to a calibrated signal generator when the site is used for radiation measurement and to a calibrated measuring receiver when the site is used for measurement of receiver characteristics.
The signal generator and the receiver shall be operating at the frequencies under investigation and shall be connected to the antenna through suitable matching and balancing networks.

### 3.8.4. *Indoor test site*

When the frequency of the signals being measured is greater than 80 MHz, use may be made of an indoor site. If this alternative site is used, this shall be recorded in the test report.
The measurement site may be a laboratory room with a minimum area of 6 metres by 7 metres and at least 2.7 metres in height.
Apart from the measuring apparatus and the operator, the room shall be as free as possible from reflecting objects other than the walls, floor and ceiling.
The potential reflections from the wall behind the equipment under test are reduced by placing a barrier of absorbent material in front of it. The corner reflector around the test antenna is used to reduce the effect of reflections from the opposite wall and from the floor and ceiling in the case of horizontally polarised measurements.
The site arrangement is in principle shown in Figure I-1 (T/R 24-03).

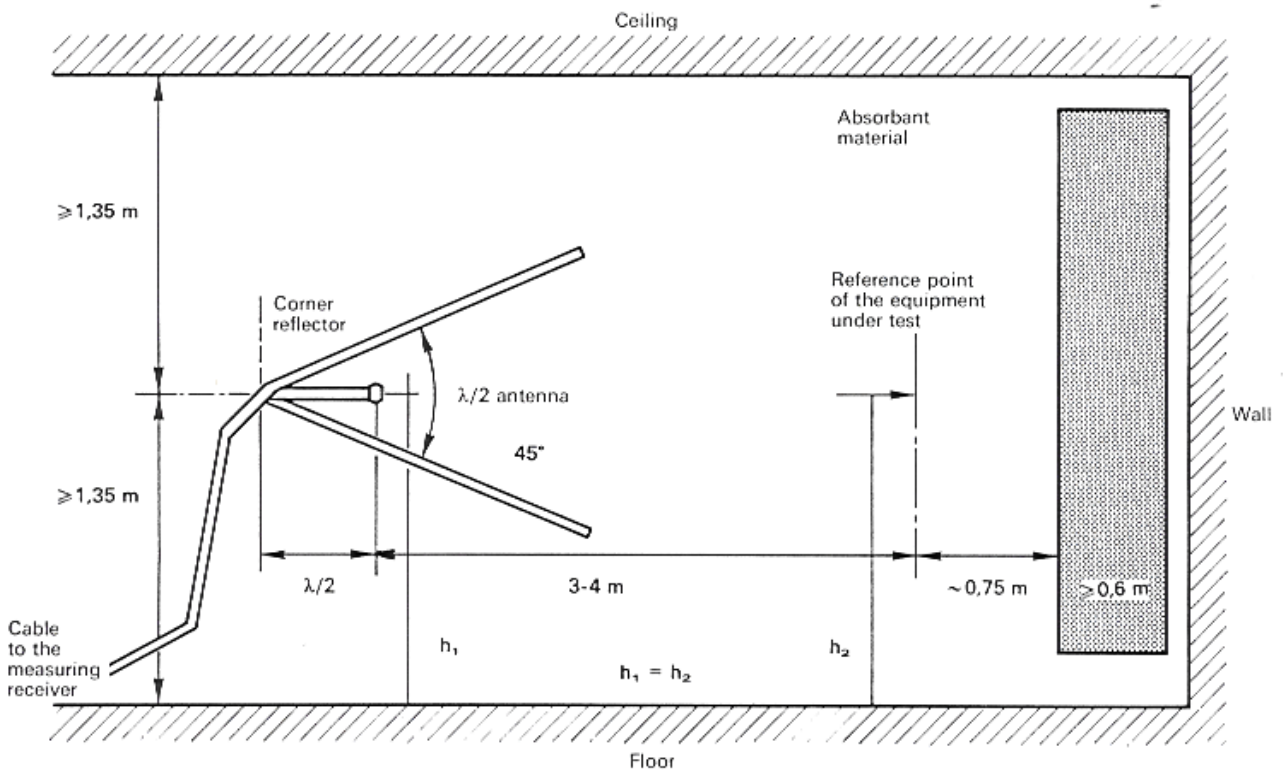


Figure I-1 (T/R 24-03). Indoor site arrangement (shown for horizontal polarisation).

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 $\lambda/2$ antenna in Figure I-1 (T/R 24-03) may be replaced by an antenna of constant length, provided that this length is between $\lambda/4$ and $\lambda$ at the frequency of measurement, and the sensitivity of the measuring system is sufficient. In the same way the distance of $\lambda/2$ to the apex may be varied.

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

To ensure that errors are not caused by the propagation path approaching the point at which phase cancellation between direct and the remaining reflected signals occurs, the substitution antenna shall be moved through a distance of $\pm$ 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 resited until a change of less than 2 dB is obtained.

## 4. TRANSMITTER

### 4.1. Frequency error

*4.1.1. Definition*

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

*4.1.2. Method of measurement*

The equipment shall be placed in a test fixture (Clause 3.7.) connected to a non-reactive non-radiating load of 50 ohms.

The carrier frequency shall be measured in the absence of modulation. The measurement shall be made under normal test conditions (Clause 2.3.) and extreme test conditions (Clauses 2.4.1. and 2.4.2. applied simultaneously).

If the equipment is constructed so that during the procedure to set up the R.F.-connection the frequency is determined by a separate technique, the measurements shall be repeated while the frequency is determined by that technique.

*4.1.3. Limits*

(a) The frequency error in the normal operation mode shall not exceed a value of ± 2.5 kHz.

(b)The frequency error of the portable part in the mode to set up the R.F.-connection (which is maximally *5* seconds (see Clause 1.4.5.)) shall not exceed ± 5 kHz.

### *4.2.* Carrier power

*4.2.1. Definition*

For the purpose of this specification, the carrier power is the effective radiated power in the direction of maximum fieldstrength under specified conditions of measurement (Clause *3.8.)* in the absence of modulation.

The rated carrier power is the effective radiated power declared by the manufacturer.

*4.2.2. Method of measurement under normal test conditions*

On a test site, fulfilling the requirements of Clause 3.8. the sample shall be placed on the support in a position:

(a) for equipment with internal antennae
- similar to the normal position when in use;

(b) for equipment with rigid external antennae
- such that the antenna is vertical;

(c) for equipment with non-rigid external antennae
- with the antenna extended vertically upwards by a non-conducting support.

The transmitter shall be switched on, without modulation, and the test receiver shall be tuned to the frequency of the signal being measured. The test antenna shall be orientated for vertical polarisation and shall be raised or lowered through the specified height range until a maximum signal level is detected on the test receiver.

The transmitter shall be rotated through 360° until a higher maximum signal is received.

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

The transmitter shall be replaced by the substitution antenna, as defined in Clause 3.8. and the test antenna 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 power is equal to the power supplied to the substitution antenna, increased by the known relationship if necessary.

A check should be made at other planes of polarisation to ensure that the value obtained above is the maximum. If larger values are obtained, this fact should be recorded in the test report.

4.2.3. *Method of measurement under extreme test conditions*

The equipment shall be placed in the test fixture (Clause 3.7.), and the power delivered to the artificial antenna shall be measured. The measurements shall be made under normal test conditions (Clause 2.3.) and extreme test conditions (Clauses 2.4.1. and 2.4.2. applied simultaneously).

The effective radiated power under extreme test conditions is determined by observing the variation of the power delivered to the artificial antenna under extreme test conditions, and then by applying this variation to the value of the effective radiated power measured on the test site.

4.2.4. *Limits*

The effective radiated power of the equipment shall not exceed 10 milliwatts.

The carrier power measured under normal and extreme test conditions shall be within +2/-4 dB of the rated carrier power.

## 4.3. Adjacent channel power

4.3.1. *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.

4.3.2. *Methods of measurement*

4.3.2.1. General remarks

Two methods are proposed, the results of which are equivalent. The member Administrations of the CEPT are requested to use one or both methods. The method applied should be stated in the test reports.

*Note.* When using the test fixture for this measurement, it is important to ensure that direct radiation from the transmitter to the power measuring receiver or spectrum analyser does not affect the results of the measurements.

4.3.2.2. Method of measurement using a power measuring receiver

The adjacent channel power shall be measured with a power measuring receiver, which conforms to Clause 4.3.2.3. (referred to in Clauses 4.3.2.2. and 4.3.2.3. as the "receiver").

(a) The transmitter shall be placed in the test fixture (Clause 3.7.) and operated at the carrier power determined in Clause 4.2. under normal test conditions (Clause 2.3.). The radio frequency output of the test fixture shall be applied to the input of the "receiver" at a level that is appropriate.

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

(c) The tuning of the "receiver" shall be adjusted away from the carrier so that the "receiver" -6°dB response nearest the transmitter carrier frequency is located at a displacement from the nominal carrier frequency of 17 kHz.

(d) The transmitter shall be modulated at 1.250 Hz at a level, which is 20 dB greater than that required to produce a depth of 60% of the frequency deviation of ±3 kHz.

(e) The "receiver" variable attenuator shall be adjusted to obtain the same meter reading as in step (b) or a known relation to it.

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

(g) The measurement shall be repeated with the "receiver" tuned to the other side of the carrier.

(h) The measurements shall be repeated while the transmitter is modulated with the normal coded test signal (Clause 3.6.). If possible this should be continuous modulation for the duration of the measurement.

(i) If the frequency error in the mode to set up the R.F.-connection (see Clauses 4.1.2. and 4.1.3.) exceeds a value of ± 2.5 kHz, then the measurements under (h) shall be repeated under extreme test conditions (Clauses 2.4.1. and 2.4.2. applied simultaneously).

* *Note.* The measurement may be made with the transmitter modulated with normal test modulation (Clause 3.4.), in which case this fact shall be recorded with test results.

4.3.2.3. Power measuring receiver specification

The power measuring receiver consists of a mixer, an IF-filter, an oscillator, an amplifier, a variable attenuator and an rms value indicator. Instead of the variable attenuator with the rms value indicator it is also possible to use a dB-calibrated rms voltmeter. The technical characteristics of the power measuring receiver are given below.

4.3.2.3.1. IF-filter

The IF-filter selectivity characteristic shall be given by Figure I-2 (T/R 24-03) below.

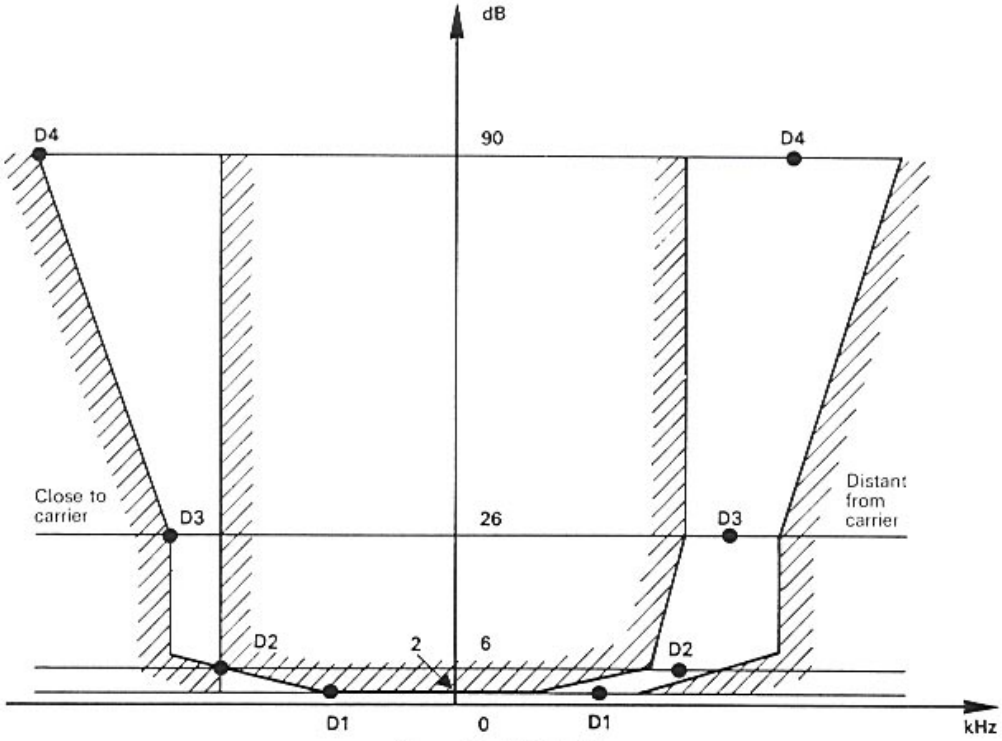


Figure I-2 (T/R 24-03).

The selectivity characteristic shall keep the following frequency separations from the nominal centre frequency of the adjacent channel.

The attenuation characteristic shall show the frequency separations from the nominal centre frequency of the adjacent channel, as mentioned in column 2 of Table I-1 (T/R 24-03).

The attenuation points on the slope towards the carrier shall not exceed the tolerances, as mentioned in column 3 of Table I-1 (T/R 24-03).

The attenuation points on the slope, distant from the carrier, shall not exceed the tolerances, as mentioned in column 4 of Table I-1 (T/R 24-03).

| 1<br>Attenuation points | 2<br>Frequency separations | 3<br>Tolerance towards carrier | 4<br>Tolerance distant from carrier |
|---|---|---|---|
| D1 ( 2 dB) | 5 kHz | +3.1 kHz | ±3.5 kHz |
| D2 ( 6 dB) | 8 kHz | ±0.1 kHz | ±3.5 kHz |
| D3 (26 dB) | 9.25 kHz | −1.35 kHz | ±3.5 kHz |
| D4 (90 dB) | 13.25 kHz | −5.35 kHz | +3.5 kHz and −7.5 kHz |

Table I-1 (T/R 24-03).

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

4.3.2.3.2. Attenuation indicator

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

4.3.2.3.3. Rms value indicator

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

4.3.2.3.4. Oscillator and amplifier

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

4.3.2.4. Method of measurement using a spectrum analyser

The adjacent channel power may be measured with a spectrum analyser, which conforms, to Clause 4.3.2.5. The transmitter shall be placed in the test fixture (Clause 3.7.) and operated at the carrier power determined in Clause 4.2. under normal test conditions (Clause 2.3.). The radio frequency output of the test fixture shall be applied to the input of a spectrum analyser at a level that is appropriate. The transmitter shall be modulated at 1.250 Hz at a level, which is 20 dB greater than that required to produce a frequency deviation of ± 3 kHz.

The spectrum analyser shall be so adjusted that the spectrum of the transmitter output, including that part which lies within the adjacent channels, is displayed.

For the purpose of this test, the bandwidth of a receiver of the type normally used in the system shall be taken to be 16 kHz, with a tolerance of ± 10%.

The centre frequency of the bandwidth within which measurements are to be made shall have a separation from the nominal carrier frequency of the transmitter equal to the channel separation for which the equipment is intended.

The adjacent channel power is the sum of the power of each of the discrete components and of the noise in the appropriate bandwidth. This sum may be calculated or an automatic power level integrating device may be used to obtain it (see Clause 4.3.2.6.).

In the latter case, the relative power level of the carrier and its sidebands are initially measured by integration in the appropriate bandwidth, centred on the nominal frequency. The integration is repeated at this bandwidth centred on the nominal frequency of the adjacent channel and the input level of the carrier signal increased until the same power level at the output of the device is obtained. The difference in the input levels, in dB, is the ratio of the adjacent channel power to the carrier output power.

The adjacent channel power, expressed as an effective radiated power, is calculated by applying this ratio to the carrier power as determined in Clause 4.2.

The measurement shall be repeated for the other adjacent channel.

The measurement shall be repeated while the transmitter is modulated by the normal coded test signal (Clause 3.6.).

4.3.2.5. Spectrum analyser specification

The specification shall include the following requirements:

It shall be possible, using a resolution bandwidth of 1 kHz, to measure the amplitude of a signal or noise at a level 3 dB or more above the noise level of the spectrum analyser, as displayed on the screen, to an accuracy of ± 2 dB in the presence of a signal separated in frequency by 10 kHz, at a level 90 dB above the level of the signal to be measured.

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

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

It shall be possible to adjust the spectrum analyser so that two components with a frequency difference of 1 kHz are displayed separately.

4.3.2.6. Integrating and power summing device

The integrating and power summing device is connected to the video output of the spectrum analyser, described in Clause 4.3.2.5.

It shall be possible to summate the effective power of all discrete components and the noise power in the selected bandwidth and to measure this as a ratio relative to the carrier power.
The position and the width of the integration range selected can be indicated on the spectrum analyser by brightening the trace.
When power levels as low as 50 nanowatts are measured, the output of the device should exceed the internal noise level by at least 10 dB. The dynamic range shall permit measurement of the values required under Clause 4.3.3. with a margin of at least 10 dB

4.3.3. *Limits*
The adjacent channel power shall not exceed a value of 10 nanowatts. The adjacent channel power of the portable part shall not exceed a value of 50 nW under normal and extreme test conditions during the period of setting up the R.F. -connection.

## 4.4. Frequency deviation

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

4.4.1. *Maximum permissible frequency deviation*

4.4.1.1. Definition
The maximum permissible frequency deviation is the maximum value of frequency deviation given in this specification.

4.4.1.2. Method of measurement
The equipment shall be placed in the test fixture (Clause 3.7.) and the frequency deviation shall be measured by sampling the signal fed to a non-reactive non-radiating load of 50 ohms by means of a deviation meter suitable for the measurement of the maximum deviation including that due to any harmonics and intermodulation products which may be produced in the transmitter. The modulation frequency shall be varied between the lowest frequency considered to be appropriate and 3 kHz. The level of this test signal shall be 20 dB above the level of the normal test modulation (Clause 3.4.).

4.4.1.3. Limits
The maximum permissible frequency deviation shall be ± 5 kHz.

4.4.2. *Response of the transmitter at modulation frequencies above 3 kHz*
4.4.2.1. Definition
The response of the transmitter at modulation frequencies above 3 kHz is the frequency deviation expressed as a function of modulation frequencies above 3 kHz.

4.4.2.2. Method of measurement
The transmitter shall be placed in the test fixture (Clause 3.7.) and operated under normal test conditions (Clause 2.3.). The transmitter shall be modulated with normal test modulation (Clause 3.4.).
With a constant input level of the modulation signal, the modulation frequency shall be varied from 3 kHz to a frequency of 25 kHz and the frequency deviation shall be measured by means of a deviation meter as described in Clause 4.4.1.2.

4.4.2.3. Limits
The frequency deviation at modulation frequencies between 3 kHz and 6 kHz shall not exceed the frequency deviation at a modulation frequency of 3 kHz. At 6 kHz the deviation shall be less than t 2.5 kHz. The frequency deviation at modulation frequencies between 6 kHz and 25 kHz shall not exceed that given by a linear response of frequency deviation (in decibels) against modulation frequency, starting at a point where the modulation frequency is 6 kHz and where the deviation is equal to t 2.5 kHz and having a slope of 14 dB per octave, the frequency deviation is diminishing as the modulation frequency is increased.

4.4.3. *Sensitivity of the modulator*
This paragraph does not apply if an overall S/N measurement of the total set is carried out in conformity with the specifications given in Recommendation T/CS 34-18.

4.4.3.1. Definition
The sensitivity of the modulator is defined as the ability of the transmitter to be sufficiently modulated when a modulation signal corresponding to the average normal speech level is applied to the input of the fixed part or to the microphone of the portable part.

4.4.3.2. Methods of measurement

4.4.3.2.1. Fixed part

A signal of 800 Hz with a level of − 10 dBm on 600 ohms shall be applied at the telephone line input of the fixed part. The frequency deviation is measured by a measuring device coupled to the transmitter aerial.

*Note.* The controls, if any, enabling the modulator sensitivity to be changed, should not be accessible to the operator.

4.4.3.2.2. Portable part

An acoustic signal of 1,000 Hz at a sound pressure level of 94 dB/2 × $10^{-5}$ Pascal shall be applied to the microphone, by means of an artificial mouth described in CCITT Recommendation P.51.

The frequency deviation is measured by a measuring device coupled to the transmitter aerial.

*Note.* The controls, if any, enabling the modulator sensitivity to be changed, should not be accessible to the operator.

4.4.3.3. Limit

The deviation resulting from these levels shall not be less than ± 3 kHz.

4.5. **Intermodulation attenuation**

This requirement applies only to transmitters to be used in the fixed part of the cordless telephone.

4.5.1. *Definition*

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

4.5.2. *Methods of measurement*

Two methods of measurement are described. Administrations may use one or both methods. The method applied shall be stated in the test report.

4.5.2.1. Method of measurement using the test site

On a test site, fulfilling the requirements of Clause 3.8., the sample shall be placed on the support in the following position:

(a) for equipment with internal antenna, it shall stand vertically, with that axis vertical which is closest to vertical in normal use;

(b) for equipment with rigid external antenna, the antenna shall be vertical.

The measuring arrangement consists of a test signal source with antenna and a selective measuring device (e.g. spectrum analyser) with a receiving antenna. The distances between the antenna of the sample, the antenna of the test signal source and the antenna of the measuring device are given in Figure I-3 (T/R 24-03).

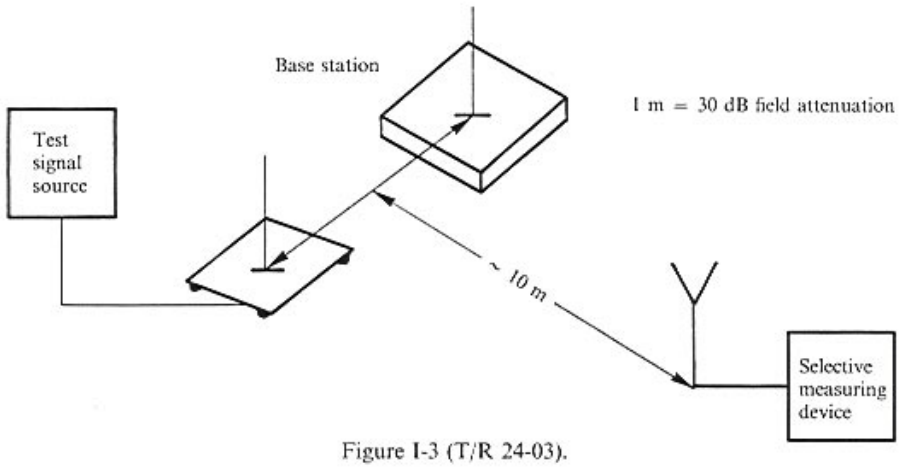


Figure I-3 (T/R 24-03).

The intermodulation components shall be measured with the test signal source and the sample switched on (both in unmodulated condition and with the same R.F.-power level) in comparing the components by means of the selective measuring device. The frequency of the test signal shall be within 1-4 neighbouring channels above and below the frequency of the transmitter under test.

When the above measurements are performed, precautions must be taken so that non-linearities in the selective measuring device do not influence the results appreciably.

Furthermore it should be ensured that intermodulation components, which may be generated in the test signal source, are sufficiently reduced, e.g. by means of an isolator.

4.5.2.2. Method of measurement using the 50 ohms antenna connector

Initially, the fixed part of the cordless telephone shall be operated as the source in a measuring arrangement as explained in Figure I-4 (T/R 24-03).

The power of the transmitter shall be measured with a selective measuring device.

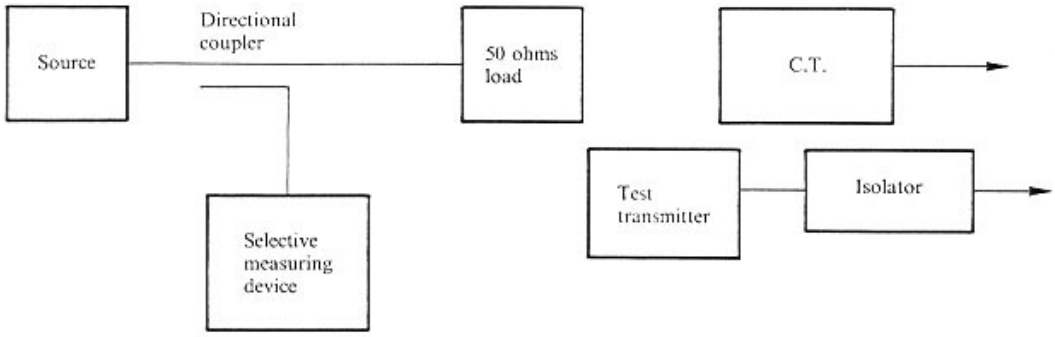


Figure I-4 (T/R 24-03).

Then, the source shall be replaced by a test transmitter with an isolator at its outlet. The frequency of this test transmitter shall be set within 1-4 neighbouring channels above and below the frequency of the fixed part of the cordless telephone. The power of the test transmitter shall be adjusted to yield a reading of 30 dB below the power of the fixed part of the C.T.

Subsequently the 50 ohms load shall be replaced by the test transmitter and isolator without changing its frequency and power settings. The fixed part of the C.T. shall be connected in place of the source.

The intermodulation attenuation shall be measured as the difference between the C.T.-carrier power and the strongest intermodulation product.

4.5.3. *Limits*

The ratio of transmitter power level and intermodulation power level shall be 45 dB.

## 4.6. Residual modulation

This paragraph does not apply if an overall S/N measurement of the total set is carried out in conformity with the specifications given in Recommendation T/S 34-18 E.

4.6.1. *Definition*

The residual modulation of the transmitter is the ratio expressed in dB of the power of the audio frequency power produced when normal test modulation is applied to the transmitter, to the audio frequency noise, produced after demodulation of the radio frequency signal, in the absence of wanted modulation, resulting from parasitic effects of the power supply unit, the modulator or other causes.

4.6.2. *Method of measurement*

The sample should be placed in the test fixture (paragraph 3.7.).

The normal test modulation defined in paragraph 3.4. is applied to the transmitter. The radio frequency signal produced by the transmitter is applied to a linear de-modulator by an appropriate coupling device. For phase modulation, the de-modulator is fitted with a de-emphasis circuit of 6 dB per octave.

All precautions shall be taken to avoid the results of the measurements being affected by low audio frequency emphasised noise of the linear de-modulator.

Measuring the signal at the output end of the de-modulator is made by means of a voltmeter, fitted with a psophometric filtering network, as described in Note P.53A of the CCITT.

The modulation is then removed and the level of the residual audio frequency output signal is again measured.

4.6.3. *Limits*
The residual modulation shall not be below 45 dB

4.7. **Spurious emissions**

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

4.7.2. *Method of measurement*
On a test site, fulfilling the requirements of Clause 3.8., the sample shall be placed at the specified height on the support. The transmitter shall be operated without modulation at the carrier power as specified under Clause 4.2.
Radiation of any spurious components shall be detected by the test antenna and receiver, over the frequency range 25 MHz - 4 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.
At each frequency at which a component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement.
The measurements shall be repeated with the test antenna in the orthogonal polarisation plane.
The measurements shall be repeated with the transmitter modulated by the normal coded test signal. If possible this should be continuous modulation for the duration of the measurement.
The measurements shall be repeated with the transmitter modulated with normal test modulation (Clause 3.4.).
The measurements shall be repeated with the transmitter in the "stand-by" position.

4.7.3. *Limits*
The power of any spurious emission shall, on any frequency and in all polarisation planes, not exceed 4 nanowatts in the frequency range up to 1.000 MHz and shall not exceed 250 nanowatts in the frequency range 1.000 MHz - 4 GHz.
In the case of measurements made in the "stand-by" position the limit is 2 nanowatts in the frequency range up to 1.000 MHz and 20 nanowatts in the frequency range 1.000 MHz - 4 GHz.
The power of any spurious emission in the frequency range 87.5 - 108 MHz, which may be modulated by understandable voice communication, shall not exceed a value of 20 pW.

5. **RECEIVER**
During receiver measurements the transmitter of the cordless telephone shall be in operation except during the measurement of spurious radiations.

5.1. **Maximum usable sensitivity and secondary sensitivity expressed as fieldstrength**

5.1.1. *Definition of the maximum usable sensitivity*
The maximum usable sensitivity is the minimum fieldstrength of a signal, at the nominal frequency of the receiver, with normal test modulation (Clause 3.4.) which will produce:
- an audio frequency output power of at least 50% of the rated output power (Clause 3.3.), and
- a SND/N[2]) ratio of 35 dB measured at the output of the receiver through a telephone psophometric weighting network as described in CCITT Recommendation P.53A.

5.1.2. *Definition of the secondary sensitivity*
The secondary sensitivity is the minimum fieldstrength of a signal, at the nominal frequency of the receiver, with normal test modulation (Clause 3.4.) which will produce:
- a SND/N[2]) ratio of 45 dB measured at the output of the receiver through a telephone psophometric weighting network as described in CCITT Recommendation P.53A.

[2]) A SND/N ratio means: S = Signal
N = Noise
D = Distortion

5.1.3. *Method of measurement*

This method makes use of the detection circuit for low fieldstrength (Clause 1.4.8.2.).

5.1.3.1. Initial tests

On a test site, fulfilling the requirements of Clause 3.8., the sample shall be placed on the support in the following position:

(a) for equipment with internal antennae, it shall stand vertically, with that axis vertical which is closest to vertical in normal use;

(b) for equipment with rigid external antennae, the antenna shall be vertical;

(c) for equipment with non-rigid external antennae, with the antenna extended vertically upwards by a non-conducting support.

The test antenna (Clause 3.8.2.) shall be at a similar distance from the receiver under test as was used between the transmitter and the test antenna in the carrier power measurement in Clause 4.2.2. The test signal fed to the test antenna from the signal source shall have a frequency equal to the nominal frequency of the receiver and shall be modulated with the normal test modulation.

The output level of the test generator is decreased from a high level until the detection circuit of the receiver is just switched, that is, at the threshold at which the receiver is considered to be out of range.

The operation shall be repeated while the receiver is rotated through 360° until the lowest value of generator output, which just operates the detection circuit, has been determined.

With the test generator output amplitude maintained at this level, the receiver under test is replaced by the substitution antenna connected to the calibrated measuring receiver and the fieldstrength, X dB relative 1 microvolt per metre is recorded.

The receiver under test is now placed in the test fixture and the above-mentioned test signal is applied to the fixture. The level of the signal shall be decreased from a high level until the detection circuit of the receiver is at the threshold.

The level of the signal generator for this criterion, Y dB relative 1 microvolt is recorded.

5.1.3.2. Methods of measurement

5.1.3.2.1. Maximum usable sensitivity

A signal of carrier frequency equal to the nominal frequency of the receiver and with normal test modulation according to Clause 3.4. shall be applied to the R.F. - input terminals of the test fixture. An audio frequency output load and a psophometric telephone weighting network as described in CCITT Recommendation P.53A shall be connected to the receiver output terminals. Where possible the receiver volume control shall be adjusted to give 50% of the rated output as defined in Clause 3.3. and, in the case of stepped volume controls, to the first step that provides an output power of at least 50% of the rated power output.

The test signal input level shall be reduced until a SND/N ratio of 35 dB is obtained. For this measurement the modulation is switched on and off. The test signal input level under these conditions is recorded as Z dB relative 1 microvolt.

The maximum usable fieldstrength sensitivity is determined by the expression: X+(Z-Y) dB relative 1 microvolt per metre.

The measurement shall be made under normal test conditions (Clause 2.3.) and extreme test conditions (Clauses 2.4.1. and 2.4.2. applied simultaneously).

Under extreme test conditions, a variation of the receiver output power of ± 3 dB relative to the value obtained under normal test conditions may be allowed.

5.1.3.2.2. Secondary sensitivity

The test signal input level shall be increased until a SND/N ratio of 45 dB is obtained. The test signal input level under these conditions is recorded as W dB relative 1 microvolt. This test is carried out under normal test conditions.

The secondary sensitivity limit is determined by the expression X+(W-Y) dB relative 1 microvolt per metre.

5.1.4. Limits

The maximum usable sensitivity expressed as fieldstrength shall not exceed 45 dB relative to 1 microvolt per metre under normal test conditions and 51 dB relative to one microvolt per metre under extreme test conditions.

The secondary sensitivity expressed as fieldstrength shall not exceed 55 dB relative to 1 microvolt per metre.

5.2. **Message acceptance**

5.2.1. *Definition*

Message acceptance is the capability of the receiver and the decoder to decode the normal coded test signal.

5.2.2. *Method of measurement*

The receiver shall be placed in a test fixture. A signal generator shall be connected to the fixture. The generator shall be set to the nominal frequency and modulated with the normal coded test signal. The output level of the generator shall be adjusted to a level that corresponds to a fieldstrength of 25 dB relative to 1 microvolt per metre around the integrated antenna of the receiver. The normal coded test signal shall be transmitted 40 times whilst observing in each case whether or not a successful response is obtained

5.2.3. *Limits*

At least 80% of the transmitted messages shall be decoded successfully.

5.3. **Co-channel rejection**

5.3.1. *Definition*

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

5.3.2. *Method of measurement*

The receiver shall be placed in a test fixture. The two input signals shall be connected to the test fixture via a combining network (see also Clause 3.1.). The wanted signal shall have normal test modulation (Clause 3.4.). The unwanted signal shall be modulated with a frequency of 400 Hz at a deviation of ± 3 kHz. Both input signals shall be at the nominal frequency of the receiver under test and the measurement repeated for displacements of the unwanted signal of up to 3 kHz.

Initially the unwanted input signal shall be switched off and the wanted input signal shall be adjusted to a level that corresponds to a fieldstrength of +55 dB relative to 1 microvolt per metre. This is achieved using Clause 5.1.3.1. after which the level Y of the test generator is increased by (55-X) dB. The unwanted signal shall then be switched on and the input level shall be adjusted until the SND/N ratio (psophometrically weighted) at the output of the receiver is reduced to 35 dB.

The co-channel rejection ratio shall be expressed as the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the test fixture input, for which the above-mentioned reduction of the SND/N ratio occurs.

5.3.3. *Limits*

The co-channel rejection ratio at any signal displacement within the specified range shall be greater than: -23 dB.

5.4. **Adjacent channel selectivity**

5.4.1. *Definition*

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

5.4.2. *Method of measurement*

The receiver shall be placed in the test fixture. The two input signals shall be connected to the test fixture via a combining network (see also Clause 3.1.).

The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (Clause 3.4.). The unwanted signal shall be modulated with a frequency of 400 Hz at a deviation off ±3 kHz and shall be at the frequency of the channel immediately above that of the wanted signal.

Initially the unwanted signal shall be switched off and the wanted input signal shall be adjusted to a level that corresponds to a fieldstrength of 55 dB relative to 1 microvolt per metre. This is achieved using Clause 5.1.3.1. after which the level Y of the test generator is increased by (55-X) dB. The unwanted signal shall be switched on and the level adjusted until the SND/N ratio at the output of the receiver, psophometrically weighted, is reduced to 35 dB.

This measurement shall be repeated with the unwanted signal at the frequency of the channel below that of the wanted signal. The adjacent channel selectivity shall be expressed as the lower value of the ratios in dB for the upper and lower adjacent channels of the level of the unwanted signal to the level of the wanted signal.

5.4.3. Limits

The ratio obtained in the measurement for adjacent channel selectivity shall be greater than 53 dB.

## 5.5. Spurious response rejection

5.5.1. *Definition*

The spurious response rejection is a measure of the capability of the receiver to discriminate between a wanted signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

5.5.2. *Method of measurement*

Two methods of measurement are described, one showing the degradation of the performance of a receiver, the other one showing unwanted responses of the receiver.
The results of both methods are considered to be comparable. Administrations may use one or both methods. The method applied shall be stated in the test report.

5.5.2.1. Method of measurement using the test fixture

Two input signals shall be applied to the receiver input via a combining network (see also Clause 3.7.). The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (Clause 3.6.).
Initially the unwanted signal shall be switched off and the wanted input signal adjusted to the value of +6 dB to an e.m.f. of 1 microvolt or so much more as is necessary to produce an SND/N ratio of 45 dB, measured at the receiver output through a telephone psophometric weighting network as described in CCITT Recommendation P.53A.
The unwanted signal shall be switched on and modulated by a frequency of 400 Hz with a deviation of 3 kHz.
The input level shall be 86 dB relative to an e.m.f. of 1 microvolt. The frequency shall then be varied over the frequency range from 25 MHz to 2 GHz.
At any frequency at which a response is obtained, except for the nominal frequency of the receiver and both the adjacent channels, the input level shall be adjusted until the unwanted signal causes:
(a) a reduction of (3) dB in the output level of the wanted signal, or
(b) a reduction to 35 dB of the SND/N ratio at the receiver output (with a psophometric filter), whether or not measured acoustically, whichever occurs first.
The spurious response protection ratio shall be expressed as the ratio in dB between the unwanted signal and the wanted signal at the receiver input when the above-mentioned reduction in the output power or in the SND/N ratio is obtained.

5.5.2.2. Method of measurement using the squelch or call-alarm circuit

This method makes use of the detection circuit for calling signals. For the duration of this test the channel scanning procedure shall be stopped.
On a test site fulfilling the requirements of Clause 3.8., the receiver shall be placed in the position used for the tests under Clause 5.1.3.1. The test signal fed to the test antenna from the signal source shall be modulated with calling messages. The output level of the test generator signal applied to the test antenna is adjusted to create a fieldstrength equal to 80 dB above the maximum usable sensitivity (Clause 5.1.) around the integral antenna of the receiver.
While changing the test antenna as necessary for each frequency band, adjust the frequency of the generator over the range 30 MHz - 2 GHz and note the frequencies at which the calling detection circuit responds. In the case of direct R.F. modulation it may be necessary to invert the polarity of the calling signal.
At each of these noted frequencies, adjust the output level of the generator until the calling detection circuit just operates.
At each frequency, the receiver is replaced by the calibrated antenna of a fieldstrength meter and the fieldstrength recorded.
The difference between these fieldstrengths and the maximum usable fieldstrength sensitivity is the measure of the spurious response rejection. It is expressed as ratio in dB.

5.5.3. *Limits*

At any frequency separated from the nominal frequency of the receiver by more than one channel spacing, the spurious response rejection shall be greater than 55 dB.

## 5.6. Intermodulation rejection

5.6.1. *Definition*

The intermodulation rejection is a measure of the capability of a receiver to inhibit the generation of in-band signals caused by the presence of two or more signals at unwanted frequencies.

5.6.2. *Method* of *measurement*

The receiver shall be placed in the test fixture.

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

Initially signal generators B and C shall be switched off. The signal from signal generator A shall be at the nominal frequency of the receiver and shall have normal test modulation (Clause 3.4.). The input to the test fixture from signal generator A shall be adjusted to give a level that corresponds to a fieldstrength of 55 dB relative to 1 microvolt per metre. This is achieved using Clause 5.1.3.1. after which the level Y of the test generator is increased by (55-X) dB.

Where possible the receiver volume control shall be adjusted to give 50% of the rated output as defined in Clause 3.3. and, in the case of stepped volume controls, to the first step that provides all output power of at least 50% of the rated power output.

The signal generator B shall be unmodulated. Signal generator B shall be adjusted to the frequency separated by the channel separation (25 kHz) above (or below) the nominal frequency of the receiver. Signal generator C shall be modulated with a frequency of 400 Hz with a deviation of ± 3 kHz. Signal generator C shall be adjusted to the frequency separated by two times the channel separation above (or below) the nominal frequency of the receiver.

The level of the output signals of generators B and C shall be kept equal and increased until the unwanted signals (generators B and C) cause a reduction to 35 dB of the SND/N ratio at the receiver output measured through a telephone psophometric weighting network as described in CCITT Recommendation P.53A.

The frequency of generator C shall be adjusted carefully to maximise the degradation. The amplitude of generators B and C shall be readjusted to reobtain the 35 dB of SND/N ratio at the receiver output.

The intermodulation rejection ratio is the ratio in dB of the output level of the two generators B and C to the level of generator A.

The measurements may be repeated for frequency separations of up to 4 and 8 times the channel separation.

5.6.3. Limits

The intermodulation rejection ratio shall not be less than 45 dB.

## 5.7. Spurious radiations

5.7.1. *Definition*

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

5.7.2. *Method of measurement*

On a test site, fulfilling the requirements of Clause 3.8., the sample shall be placed at the specified height on the support. The receiver shall be operated from the normal power source. Radiation of any spurious components shall be detected by the test antenna and receiver.

At each frequency at which a component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement. At each spurious radiation in the frequency range 87.5 - 108 MHz it shall be investigated whether or not this spurious emission may be modulated with understandable voice communication.

The measurement shall be repeated with the test antenna in the orthogonal polarisation plane. The measurement shall extend over a frequency range of 25 MHz to 4 GHz.

5.7.3. *Limits*

The power of any spurious radiation of the receivers shall not exceed 2 nanowatts in the frequency range up to 1 GHz and 20 nanowatts in the frequency range 1.000 MHz - 4 GHz.

The power of any spurious radiation in the frequency range 87.5 - 108 MHz, which may be modulated by understandable voice communication, shall not exceed a value of 20 pW.

## 6. ADDITIONAL REQUIREMENTS

Audio frequency response and harmonic distortion factor of the cordless telephone.

### 6.1. Definitions

The definitions of the audio frequency response and of the harmonic distortion factor are the same as those applicable to a normal telephone set.

### 6.2. Method of measurement

The method of measurement, which is used, for a normal telephone set shall also be applied for the two parts of the cordless telephone. These shall be placed on isolating supports on a test site fulfilling the requirements of Clause 3.8. Measurements shall be carried out within the audio frequency range 300 - 3.000 Hz.

### 6.3. Limits

The limits which apply for a normal telephone set apply to a cordless telephone set with a relaxation for the audio frequency response of + and -3 dB in the frequency ranges below 0.5 kHz and above 2.2 kHz for the audio frequency response.

## 7. PRESENTATION OF EQUIPMENT FOR TYPE APPROVAL

### 7.1. Choice of model for type approval

The manufacturer shall provide a production model of the equipment for type approval testing. If type approval is given on the basis of tests on a preliminary model, then the corresponding production models must be identical in all respects with the preliminary model tested.

### 7.2 Channel selection

Any channel within the specified frequencies given in this Recommendation may be selected for type approval testing. Type approval tests will be carried out on all the channels, which the testing authority judges necessary.

## 8. ACCURACY OF MEASUREMENTS

The tolerance for the measurement of the following parameters shall be as given below:

| | | |
|---|---|---|
| 8.1.1. | DC voltage | ± 3% |
| 8.1.2. | AC mains voltage | ± 3% |
| 8.1.3. | AC mains frequency | ± 0.5% |
| 8.2.1. | Audio frequency voltage, power, etc. | ± 0.5 dB |
| 8.2.2. | Audio frequency | ± 1% |
| 8.2.3. | Distortion and noise, etc., of audio frequency generators | 1% |
| 8.3.1. | Radio frequency | ± 50 Hz |
| 8.3.2. | Radio frequency voltage | ± 2 dB |
| 8.3.3. | Radio frequency fieldstrength | ± 3 dB |
| 8.3.4. | Radio frequency carrier power (e.r.p.) | ± 2 dB |
| 8.3.5. | Radio frequency adjacent channel power | ± 3 dB |
| 8.4.1. | Impedance of artificial loads, combining units, cables, plugs, attenuators, etc. | ± 5% |
| 8.4.2. | Source impedance of generators and input impedance of measuring receivers | ± 10% |
| 8.4.3. | Attenuation by attenuators | ± 0.5 dB |
| 8.5.1. | Temperature | ± 1° C |
| 8.5.2. | Humidity | ± 5% |
| 8.5.3. | Time | ± 10% |

## Appendix A

## GUIDE ON THE USE OF RADIATION TEST SITES

For measurements involving the use of radiated fields, use may be made of a test site in conformity with the requirements of paragraph 3.8. of this Appendix. When using such a test site, the following conditions should be observed to ensure consistency of measuring results.

A.1 **Measuring distance**

Evidence indicates that the measuring distance is not critical and does not significantly affect the measuring results, provided that the distance is not less than 7 $\lambda/2$ or 5 metres, whichever is shorter, at the frequency of measurement, and the precautions described in this Appendix are observed.
Measuring distances of 3 m, 5 m, 10 m and 30 m are in common use in the CEPT countries.

A.2 **Test antenna**

Different types of test antennae may be used, since to performing substitution measurements, calibration errors of the test antenna do not affect the measuring results.
Height variation of the test antenna over a range of 1-4 metres is essential in order to find the point at which the radiation is a maximum.
Height variation of the test antenna may not be necessary at the lower frequencies below about 100 MHz.

A.3. **Substitution antenna**

Variations in the measuring results may occur with the use of different types of substitution antennae at the lower frequencies below about 80 MHz. Where a shortened dipole antenna is used at these frequencies, details of the type of antenna used should be included with the results of the tests carried out on the site.

A.4. **Auxiliary cables**

The position of auxiliary cables (power supply and microphone cables, etc.) which are not adequately decoupled may cause variations in the measuring results. In order to get reproducible results, cables and wires of auxiliaries are mounted vertically downwards (through a hole in the isolating table or in the base plate of the salt water column), and shall be fitted at the upper part with a radio frequency stop filter (for instance using ferrite cores).