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Contents

Foreword

This Interim European Telecommunication Standard (I-ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This I-ETS contains text pertaining to approval testing of the Digital European Cordless Telecommunications (DECT) Common Interface.

Such text should be considered as guidance to approval (or licensing) authorities.

The Public Access Profile (PAP) Clause contains an Applicant's Declaration. Extensive tests for the PAP are currently under development. It is intended to add these to the TBR 11 when available.

Network attachment requirements will be referred from TBRs.

Details of the DECT Common Interface may be found in ETS 300 175.

Further details of the DECT system may be found in the ETSI Technical Reports, ETR 015 [11], and ETR 043 [10], and also in the draft ETSI Technical Report, "Digital European Cordless Telecommunications System Description Document" [12].

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1 Scope

This Interim European Telecommunication Standard (I-ETS) specifies the approval tests applicable to all Digital European Cordless Telecommunications (DECT) equipment.

Its aims are to ensure the following:

- efficient use of the radio frequency spectrum;
- no harm is done to any connected network and its services as well as to other radio networks and services;
- no harm is done to other DECT equipment and its services;
- inter-operability between DECT equipment intended for public access.

2 Normative references

This Interim European Telecommunication Standard (I-ETS) incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this I-ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETS 300 175-1: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 1: Overview".

[2] ETS 300 175-2: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 2: Physical layer".

[3] ETS 300 175-3: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 3: Medium access control layer".

[4] ETS 300 175-4: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 4: Data link control layer".

[5] ETS 300 175-5: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 5: Network layer".

[6] ETS 300 175-6: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 6: Identities and addressing".

[7] ETS 300 175-7: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 7: Security features".

[8] ETS 300 175-8: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 8: Speech coding and transmission".

[9] ETS 300 175-9: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 9: Public access profile".

[10] ETR 043: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Services and facilities requirements specification".

[11] ETR 015: "Digital European Cordless Telecommunications Reference Document".

[12] Draft ETSI Technical Report: "Digital European Cordless Telecommunications System Description Document".

[13] ISO Publication DIS 9646 (ISO/IEC JTC 1/SC 21) (1989): "Information Retrieval, Transfer and Management for OSI".

[14] ETS 300 085 (1991): "Integrated Services Digital Network (ISDN); 3,1 kHz telephony teleservice. Attachment requirements for handset terminals" (NET 33).

[15] Reserved.

[16] CCITT Recommendation G.721 (1988): "32 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)".

[17] CCITT Recommendation G.122 (1988): "Influence of national systems on stability, talker echo, and listener echo in international connections".

[18] CCITT Recommendation G.132 (1988): "Attenuation Distortion".

[19] CCITT Recommendation G.223 (1964 with amendments): "Assumptions for the calculation of noise on hypothetical reference circuits for telephony".

[20] CCITT Recommendation G.714 (1988): "Separate performance characteristics for the encoding and decoding sides of PCM channels applicable to 4-wire voice frequency interfaces".

[21] CCITT Recommendation P.51 (1988): "Artificial ear and artificial mouth".

[22] CCITT Recommendation P.64 (1988): "Determination of sensitivity/frequency characteristics of local telephone systems to permit calculation of their loudness ratings".

[23] CCITT Recommendation P.79 (1988): "Calculation of loudness ratings".

[24] CCITT Recommendation G.711 (1972 with amendments): "Pulse Code Modulation (PCM) of voice frequencies".

[25] CCITT Recommendation P.76 (1988): "Determination of loudness ratings; fundamental principles".

[26] CCITT Recommendation P.65 (1988): "Objective instrumentation for the determination of loudness ratings".

[27] CCITT Series P Recommendations (1988), Volume V; "Telephone Transmission Quality".

[28] ISO Publication 3 (1973): "Preferred numbers - series of preferred numbers".

[29] CCITT Recommendation V.11 (1988): "Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications".

[30] CCITT Recommendation P.50 (1988): "Artificial Voices".

[31] CCITT Recommendation O.153 (1988): "Basic parameters for the measurement of error performance at bit rates below the primary rate".

[32] IEC 651: "Soud level meters".

3 Definitions, symbols and abbreviations

3.1 Manufacturer's declaration

Where parameters, capabilities, etc., are subject to manufacturer's declaration and not a specific test, it will be the manufacturer's responsibility to:

a) supply the measured value of the parameter, characteristic, etc.;

b) be prepared to submit full details as to how the item was tested, the test results, and in general full documentary evidence that the testing was valid;

c) be prepared if necessary to reproduce the tests on demand.

3.2 Definitions

For the purposes of this I-ETS, the following definitions apply:

Accreditation body: the body which is concerned with approving the equipment based upon the results of the test authority.

Antenna diversity: antenna diversity implies that the Radio Fixed Part (RFP) for each bearer independently can select different antenna properties such as gain, polarisation, coverage patterns, and other features that may effect the practical coverage. A typical example is space diversity, provided by two vertically polarised antennas separated by 10 - 20 cm.

Bearer handover: the internal handover process provided by the Medium Access Control (MAC) layer, whereby one MAC connection can modify its underlying bearers while maintaining the service provided to the Data Link Control (DLC) layer.

NOTE: Bearer handover is slot based.

Cell: the domain served by a single antenna system (including a leaky feeder) of one fixed part.

NOTE: A cell may include more than one source of radiated Radio Frequency (RF) energy (i.e. more than one radio end point).

Central Control Fixed Part (CCFP): a physical grouping that contains the central elements of a fixed part. A fixed part shall contain a maximum of one CCFP.

NOTE: A CCFP controls one or more RFPs.

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

Connection handover: the internal handover process provided by the DLC layer, whereby one set of DLC entities (C-plane and U-plane) can reroute data from one MAC connection to a second new MAC connection, while maintaining the service provided to the network layer.

NOTE: Connection handover is DLC frame based.

DECT-like carrier: this is a modulated RF DECT carrier used for interference testing which conforms to the requirements in ETS 300 175-2 [2] in terms of frequency and timing and uses a pseudo-random sequence for modulation.

Double slot (slot): one 12th of a TDMA frame which is used to support one high capacity physical channel.

Duplex bearer: the use of two simplex bearers operating in opposite directions on two physical channels. These pairs of channels shall always use the same RF carrier and shall always use evenly spaced slots (i.e. separated by 0,5 TDMA frame).

Implementation Under Test (IUT): this is the equipment submitted to the test authority for approval testing.

External handover: the process of switching a call in progress from one fixed radio termination to another fixed radio termination.

Fixed geometry PP: a Portable Part (PP) in which the electro-acoustic transducers and their associated acoustic components are held in fixed relative positions and/or orientations during all on-line conditions of the PP.

Fixed Part (DECT fixed part) (FP): a physical grouping that contains all of the elements in the DECT network between the local network and the DECT air interface.

NOTE: A DECT fixed part contains the logical elements of at least one fixed radio termination, plus additional implementation specific elements.

Fixed radio Termination (FT): a logical group of functions that contains all of the DECT processes and procedures on the fixed side of the DECT air interface.

NOTE: A fixed radio termination only includes elements that are defined in the DECT CI standard. This includes radio transmission elements (layer 1) together with a selection of layer 2 and layer 3 elements.

Full slot (slot): one 24th of a TDMA frame which is used to support one physical channel.

Half slot: one 48th of a TDMA frame which is used to support one physical channel.

Handover: the process of switching a call in progress from one physical channel to another physical channel. These processes can be internal (see internal handover) or external (see external handover).

NOTE: There are two physical forms of handover: intra-cell handover and inter-cell handover. Intra-cell handover is always internal. Inter-cell handover can be internal or external.

Handset echo: the echo, perceptible by the far-end user, resulting from the coupling between the receive and send directions of the handset, mostly due to acoustic coupling between transducers. It is particularly cumbersome in communications including a satellite and an echo canceller, as the DECT handset echo may be out of range of the echo canceller.

Incoming call: a call received at a portable part.

Inter-cell handover: the switching of a call in progress from one cell to another cell.

NOTE: This only defines the form of handover, it does not define a specific process.

Intra-cell handover: the switching of a call in progress from one physical channel of one cell to another physical channel of the same cell.

NOTE: This only defines the form of handover, it does not define a specific process.

Inter-operability: the capability of fixed parts and portable parts, that enable a portable part to obtain access to teleservices in more than one location area and/or from more than one operator (more than one service provider).

Lower Tester (LT): a logical grouping that contains the test equipment, a functionally equivalent DECT PT, a functionally equivalent DECT FT and a test controller.

MAC bearer (bearer): MAC bearers are the service elements that are provided by each Cell Site Function (CSF). Each MAC bearer corresponds to a single service instance to the physical layer. See also simplex bearer, duplex bearer and double simplex bearer.

Multiframe: a repeating sequence of 16 successive TDMA frames, that allows low rate or sporadic information to be multiplexed (e.g. basic system information or paging).

Network echo: the echo, perceptible by the DECT user, resulting from refections in the network. It is mostly due to hybrid impairments at both ends of the communication. The protection consists in an additional echo loss located in the receive path of the DECT system.

Physical channel (channel): the simplex channel that is created by transmitting in one particular slot on one particular RF channel in successive TDMA frames. See also simplex bearer.

NOTE: One physical channel provides a simplex service. Two physical channels are required to provide a duplex service.

Portable HandSet (PHS): a single physical grouping that contains all of the portable elements that are needed to provide a teleservice to the user.

NOTE: Portable handset is a subset of all possible portable parts. This subset includes all physical groupings that combine one portable radio termination plus at least one portable application in a single physical box.

Portable Part (PP): a physical grouping that contains all elements between the user and the DECT air interface. Portable Part (PP) is a generic term that may describe one or several physical pieces.

NOTE: A portable part is logically divided into one portable termination plus one or more portable applications.

Portable radio Termination (PT): a logical group of functions that contains all of the DECT processes and procedures on the portable side of the DECT air interface.

NOTE: A portable radio termination only includes elements that are defined in the DECT CI standard. This includes radio transmission elements together with a selection of layer 2 and layer 3 elements.

Public: an attribute indicating that the application of the so qualified term is used to provide access to a public network for the general public.

NOTE: The term does not imply any legal or regulatory aspect, nor does it imply any aspects of ownership.

Public Access Profile (PAP): a defined part of the DECT common interface standard (DECT CI) that ensures inter-operability between fixed parts and portable parts for public access services.

Public access service: a service that provides access to a public network for the general public.

NOTE: The term does not imply any legal or regulatory aspect, nor does it imply any aspects of ownership.

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

Radio End Point (REP): a physical grouping that contains one radio transmitter/receiver, fixed or portable.

NOTE: A radio end point may operate only as a receiver or only as a transmitter.

Radio Fixed Part (RFP): one physical sub-group of a fixed part that contains all the radio end points (one or more) that are connected to a single system of antennas.

TDMA frame: a time-division multiplex of 10 ms duration, containing 24 successive full slots. A TDMA frame starts with the first bit period of full slot 0 and ends with the last bit period of full slot 23.

Test authority: that body which is concerned with the testing of equipment submitted by a manufacturer for approval.

Test load: the test load is a substantially non-reactive, non-radiating power attenuator which is capable of safely dissipating the power from the transmitter(s).

Upper Tester (UT): a logical grouping that controls the IUT when under test.

NOTE: Commands are sent from the LT to the UT to place the IUT in the appropriate test mode.

Variable geometry PP: a PP that allows the position and/or orientation of its electro-acoustic transducers and their associated acoustic components to be changed during all on-line conditions of the PP.

3.3 Abbreviations

For the purpose of this I-ETS, the following abbreviations apply:

AM	Amplitude Modulation
ARL	Acoustic Reference Level
BER	Bit Error Rate
BT	Bandwidth Time
CLRR	Circuit Loudness Rating, Receive
CLRS	Circuit Loudness Rating, Send
dBm	dB relative to 1 milliwatt
dBm0	The absolute power level in decibels referred to a point of zero relative level
dBr	The relative power level in decibels
DTMF	Dual Tone Multi Frequency
emf	electro-motive force
IUT	Implementation Under Test
FP	Fixed Part
FT	Fixed Radio Termination
Lmest	Sidetone Path Loss
LE	Local echo
LNR	Low Noise Room
LRGP	Loudness Rating Guard-ring Position

LSTR	Listener Sidetone Rating
LT	Lower Tester
MRP	Mouth Reference Point
NTP	Normal Transmitted Power
PABX	Private Automatic Branch Exchange
PAP	Public Access Profile
PCM	Pulse Code Modulation
PP	Portable Part
PT	Portable Radio Termination
ReFP	Reference Fixed Part (for speech testing)
RePP	Reference Portable Part (for speech testing)
RFP	Radio Fixed Part
RLR_H	Receive Loudness Rating of the Handset
SLR_H	Send Loudness Rating of the Handset
STMR	Sidetone Masking Rating
TELR	Talker's Echo Loudness Rating
TBC	Traffic Bearer Controller (refer to ETS 300 175-3 [3])
TCLw	Weighted Terminal Coupling Loss
UAK	User Authentication Key
UPI	User Personal Identification
UT	Upper Tester
VSWR	Voltage Standing Wave Ratio

4 General

4.1 Document layout

The test cases described in these Clauses are intended to follow the ISO Publication 9646 [13] recommendations as closely as possible. However, for practical reasons it was not always possible to follow the guide-lines exactly and the following paragraphs will describe the relation of this I-ETS to ISO Publication 9646 [13].

4.1.1 Test suites

The term "test suite" is defined in ISO Publication 9646 [13].

The following table lists the test suites that have been described in this document and the test groups that are associated with them.

Table 1

Test suite	Test groups
DECT physical layer	Physical layer services Transmission of physical packets Reception of physical packets
Speech	Speech
Public Access Profile	Handover

4.1.2 Test groups

The term "test group" is defined in ISO Publication 9646 [13].

The following table lists the test groups that are described in this I-ETS and the test cases that are associated with them.

Table 2

Test group	Test cases
Physical layer services	1 2 3 4
Transmission of physical packets	5 6 7 8 9 10 11 12 13
Reception of physical packets	14 15 16 17 18 19 20
Speech	22-53
Handover	54

4.1.3 Test cases

The term "test case" is defined in ISO Publication 9646 [13].

The following table lists the test cases that are described in this I-ETS.

Table 3

Test Case	Test case	Clause\ Subclause Number
1	Accuracy and stability of RF carriers	7
2	Timing jitter: slot-slot on the same channel	8.3
3	Timing jitter: bit-bit, same slot,same channel	8.4
4	Reference timing accuracy of a RFP	8.5
5	Transmission Burst	9
6	Transmitted power: PP and RFP with an integral antenna	10.2
7	Transmitted power: PP and RFP with an external antenna connector	10.3
8	RF carrier modulation	11
9	Emissions due to modulation	12.2
10	Emissions due to transmitter transients	12.3
11	Emissions due to intermodulation	12.4
12	Out of band emissions when transmitting	12.5
13	Emissions between transmit bursts	12.6
14	Radio receiver sensitivity	13.1
15	Radio receiver irreducible bit error rate	13.2
16	Radio receiver interference performance	13.3
17	Radio receiver blocking case 1	13.4
18	Radio receiver blocking case 2	13.5
19	Receiver intermodulation performance	13.6
20	Spurious emissions when receiving or idling	13.7
21	Synchronisation port	14
22	Sending sensitivity frequency response	15.7
23	Receiving sensitivity frequency response	15.8
24	PP loudness rating	15.9
25	User controlled volume control in PP	15.10
26	PP adaptive volume control	15.11
27	FP adaptive volume control	15.12
28	PP talker sidetone masking rating	15.13
29	Listener sidetone	15.14
30	Echo loss	15.15
31	FP with 4-wire interface and artificial echo loss	15.16
32	FP with 4-wire interface and an echo control device	15.17
33	Stability loss - fixed geometry	15.18
34	Stability loss variable geometry	15.19
35	Sending distortion	15.20
36	Receiving distortion	15.21
37	Side tone distortion	15.22
38	Variation of gain with input level	15.23
39	Out of band (sending)	15.24
40	Out of band (receiving)	15.25
41	Sending noise	15.26
42	Sending noise (narrow band)	15.27
43	Receiving noise	15.28
44	Sampling frequency level (receiving)	15.29
45	Acoustic shock	15.30
46	DECT network delay	15.31
47	PP delay	15.32
48	FP delay	15.33
49	Network echo control	15.34
50	PP ambient noise rejection	15.35
51	Loudspeaker and hands-free facilities	15.36
52	Bearer handover	16.1.72

NOTE: PAP tests are listed in Clause 16.

4.2 Presentation of equipment for testing purposes

Each equipment submitted for approval testing shall fulfill the requirements of this I-ETS on all DECT RF channels.

4.2.1 Choice of model for approval testing

The applicant shall provide one or more preliminary or production model(s) of the equipment, as appropriate, for approval testing.

If 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.

4.2.2 Description of equipment

The applicant shall provide the following information to the test authority.

4.2.2.1 Protocol Implementation Conformance Specification (PICS)

A statement made by the applicant stating which capabilities and options have been implemented, including whether the equipment implements the Public Access Profile (PAP).

4.2.2.2 Protocol Implementation eXtra Information for Testing (PIXIT)

A statement made by the applicant which contains or references all of the information (in addition to that given in the PICS) related to the IUT and it's testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT.

This shall include:

- the method by which the equipment can be mechanically switched into the test standby mode. This mode is described in subclause 5.10.2;

- whether the equipment has one or more internal or external antennas;

- whether the equipment has antenna diversity.

4.2.2.3 Environmental test conditions

The manufacturer shall supply for FPs, RFPs, and CCFPs, a statement indicating the class of use for the IUT, i.e., "Class E1 Use" or "Class E2 Use".

4.3 Mechanical and electrical design

4.3.1 General

The equipment submitted for approval testing by the applicant or his representative shall be designed, constructed and manufactured in accordance with sound engineering practice, and with the aim to minimise harmful interference to other equipment and services.

4.3.2 Controls

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

4.4 Applicability of approval tests

The applicability of the individual approval tests in this document are dependent on the type of equipment submitted for approval. The following subclauses list the applicable approval tests. Equipment may contain one or more of the features listed in the following subclauses. It is assumed that all equipment contains a

radio receiver. All DECT equipment shall be able to operate on each of the 10 DECT RF channels allocated.

4.4.1 All equipment

The approval tests contained in Clause 13 of this document shall be applied. For DECT equipment not incorporating a radio transmitter, a test point permitting receiver testing as given in Clause 13 shall be provided by the applicant in the equipment supplied to the testing authority.

4.4.2 Equipment that includes a radio transmitter

The approval tests contained in Clauses 7, 8, 9, 10, 11, 12, and 13, of this I-ETS shall be applied.

4.4.3 Equipment that is to transmit and receive speech

The approval tests contained in Clause 15 of this I-ETS shall be applied.

4.4.4 Equipment that is to be declared as complying with the Public Access Profile (PAP)

The approval tests contained in Clause 16 of this I-ETS shall be applied.

4.4.5 Equipment declared as having implemented bearer handover

The approval tests contained in subclause 16.1.72 of this I-ETS shall be applied.

4.4.6 Equipment with a synchronisation port

The approval tests contained in Clause 14 of this I-ETS shall be applied.

4.5 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in this I-ETS shall be as follows:

a) the measured value related to the corresponding limit will be used to decide whether an equipment meets the minimum requirements of the standard;

b) the actual measurement uncertainty of the test laboratory carrying out the measurement, for each particular measurement, shall be included in the test report;

c) the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures in subclause 5.9.5 (table of measurement uncertainty).

5 General test requirements

5.1 Test philosophy

All the tests in this document are based upon a common philosophy. This philosophy assumes that test equipment is capable of emulating a PT or FT that conforms to the DECT CI specification. Consequently, each test set-up consists of the test equipment being connected to the IUT, either by a radio link or via an antenna connector. The following figures show the possible test configurations.

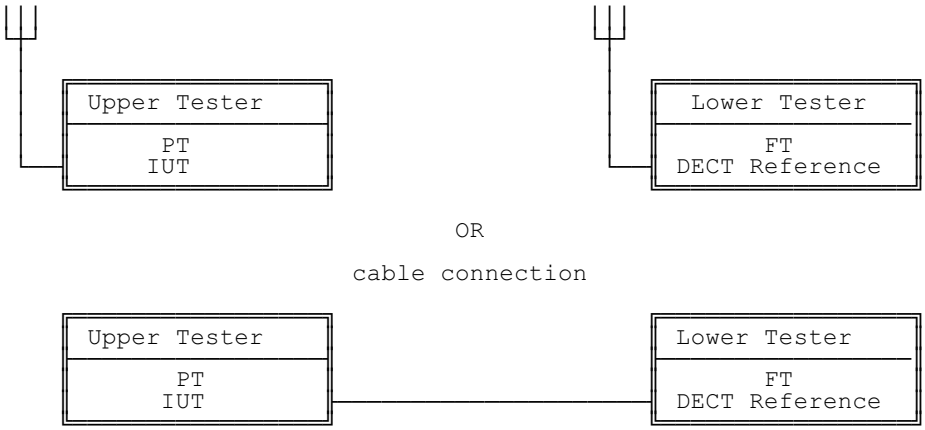


Figure 1: The IUT is a PT

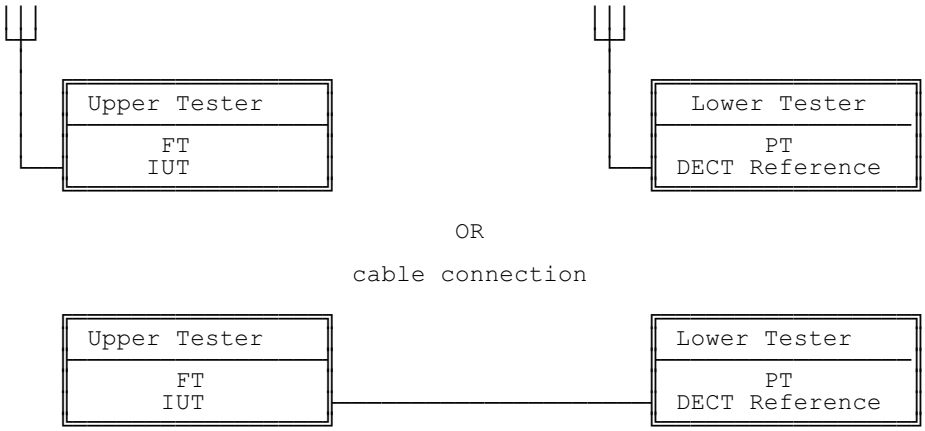


Figure 2: The IUT is a FT

Figures 1 and 2 also show that, if available, the IUT can sometimes be connected to the LT by an antenna connector. This is normally preferred in order to minimise the measurement uncertainties, however, in some test cases this is not permitted and is stated as such in each test case.

The Lower Tester (LT) will consist of the general test equipment with the functionality as described in subclause 5.9. Also it will include an RF interface which can emulate a reference DECT PT or FT. The Reference DECT PT and FT (see subclause 5.11) is an implementation of the DECT CI specification including all the mandatory services and facilities and some provision optional, process mandatory elements as well.

The Upper Test unit (UT) is contained within the IUT and operates in response to test commands which are sent by the LT over the air interface. This enables the LT to place the IUT in a variety of test modes. These are described in subclause 5.10.

5.2 Test site

5.2.1 Open air test site

5.2.1.1 Description

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

An open air test site may be used to perform the measurements using the radiated measurement methods described in Annex B of this I-ETS in the frequency range over which the site can be calibrated. Absolute or relative measurements can be performed on transmitters or receivers; absolute measurements require a calibration of the test site.

The distance between the equipment under test or substitution antenna and the test antenna will be in accordance with current testing practice. Measuring distances of 3, 5, 10, and 30 m are in common use in European test laboratories. A measurement distance of 1 metre may be used for frequencies above 1 GHz if the dimensions of the test antenna is less than $[1 \text{ metre} \times \text{lambda}/2]^{1/2}$.

The test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of lambda/2 at the frequency of measurement or 3 metres (1 metre above 1 GHz), whichever is the greater. 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 be variable between 1 and 4 m. The support for the equipment or substitution antenna shall be capable of 360° rotation and be made of a non-conductive material. The overall size of the open air test site shall be approximately 2 x D m by 3 x D m, 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 (at least 5 metres in diameter) to provide consistent ground reflections. The support for the equipment or substitution antenna shall be positioned in the middle of the ground plane. 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.

5.2.1.2 Calibration

5.2.1.2.1 For emissions radiated by the IUT

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

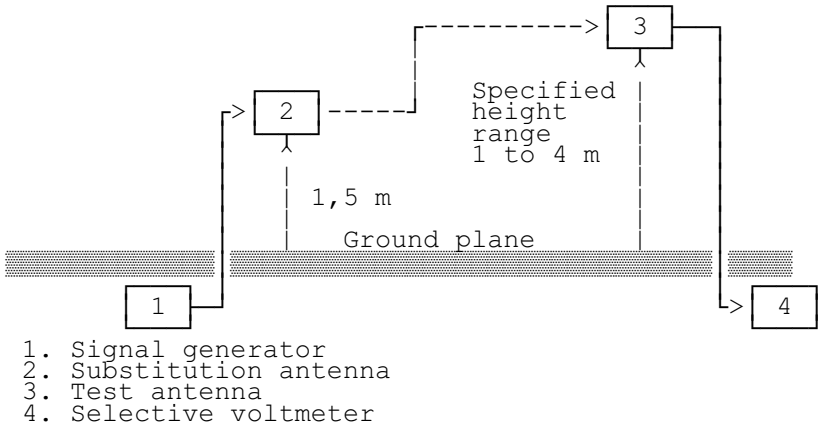


Figure 3: Measuring arrangement for calibration

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 test antenna connected to the selective voltmeter constitutes a calibrated field strength metre.

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.

5.2.1.2.2 For emissions radiated into the IUT

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 substitution antenna.

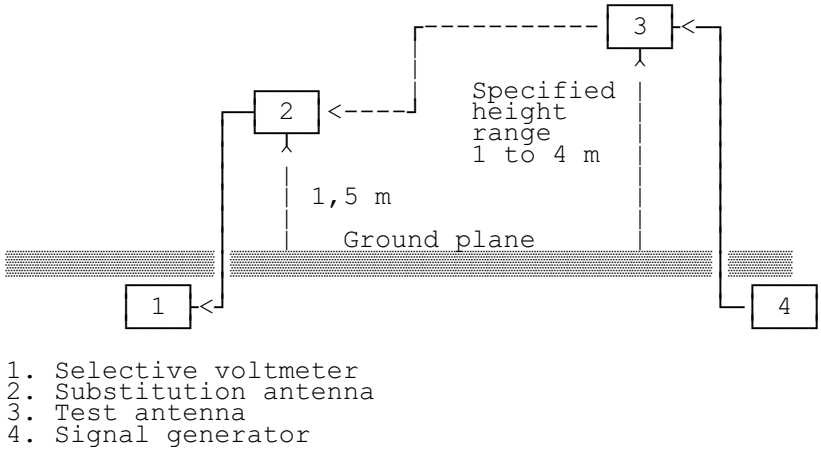


Figure 4: Measuring arrangement for calibration of emissions radiated into the IUT

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 metre:

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.

5.2.2 Anechoic chamber

5.2.2.1 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 Annex B of this I-ETS in the frequency range over which it can be calibrated. Absolute or relative measurements can be performed on transmitters or on receivers. Absolute measurements 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.

5.2.2.2 Description

An anechoic chamber should meet the requirements for shielding loss and wall return loss as shown in figure 5. Figure 6 shows an example of the construction of an anechoic chamber having a base area of 5 metres by 10 metres and a height of 5 metres. The ceiling and walls are coated with pyramidally formed absorbers approximately 1 metre high. The base is covered with special absorbers which form the floor. The available internal dimensions of the chamber are 3 metres by 8 metres by 3 metres, so that a maximum measuring distance of 5 metres in the middle axis of this chamber is available (for more information, see Annex A, [2]). The floor absorbers reject floor reflections so that the antenna height need not be changed. Anechoic chambers of other dimensions may be used.

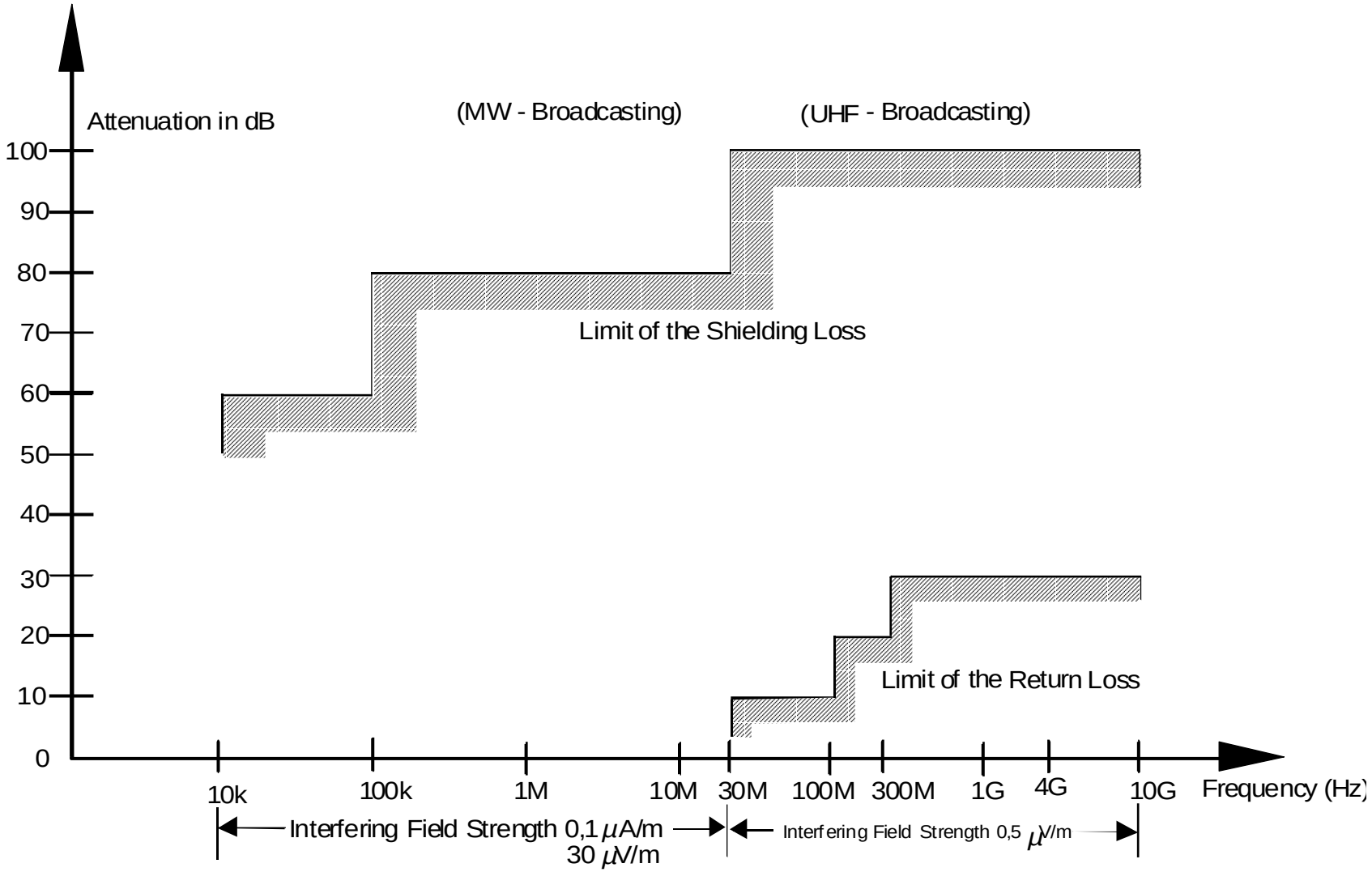
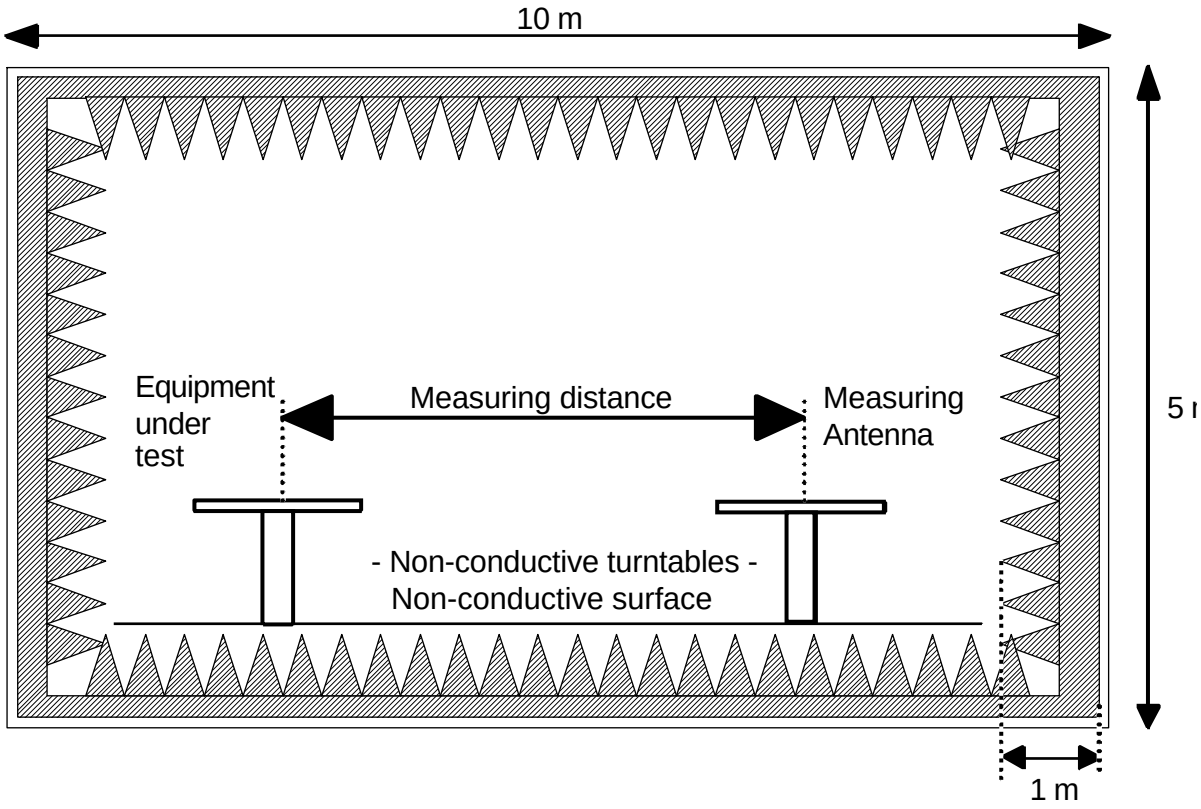

Attenuation in dB
100
90
80
70
60
50
40
30
20
10
0
(MW - Broadcasting)
(UHF - Broadcasting)
Limit of the Shielding Loss
Limit of the Return Loss
10k
100k
1M
10M
30M
100M
300M
1G
4G
10G
Frequency (Hz)
Interfering Field Strength 0,1 μA/m
30 μV/m
Interfering Field Strength 0,5 μV/m

Figure 5


10 m
Equipment
under
test
Measuring distance
Measuring
Antenna
- Non-conductive turntables -
Non-conductive surface
5 m
1 m

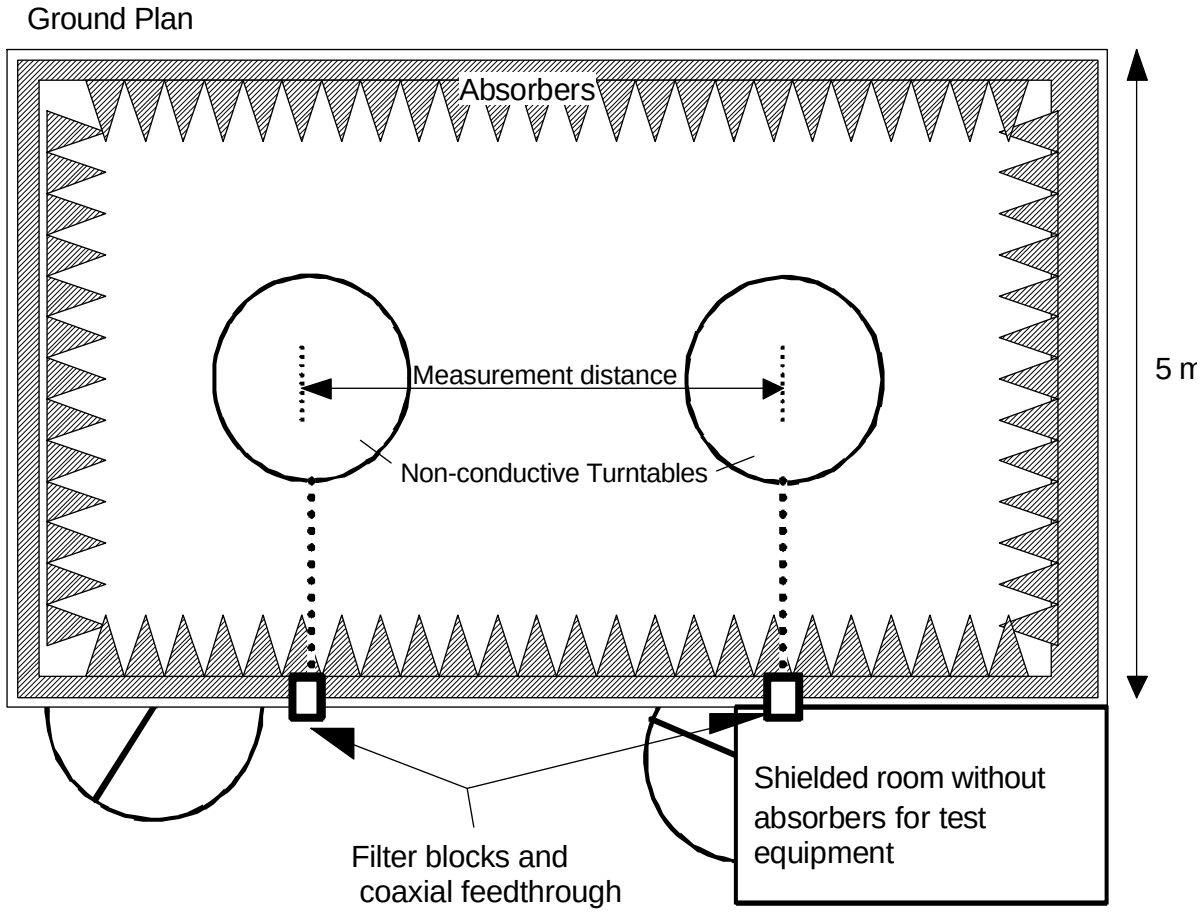

Ground Plan
Absorbers
Measurement distance
Non-conductive Turntables
5 m
Shielded room without
absorbers for test
equipment
Filter blocks and
coaxial feedthrough

Figure 6

5.2.2.3 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 $X = X_0 \times (R_0/R)$, where X_0 is the reference field strength and R_0 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 above 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.

5.2.2.4 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.

5.2.3 Low noise room

Low noise refers to sound and not RF radiation.

The test space shall be practically free-field (anechoic) down to a lowest frequency of 275 Hz, and be such that the handset lies totally within the free-field volume. This is met where the reverberation distance is ≥ 50 cm. The ambient noise level shall be less than 30 dBA. Measurements made in the low noise room must satisfy the measurement uncertainty requirements described in subclause 5.9.5.

5.2.4 Stripline coupler

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 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**.

5.2.4.1 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.

An example of a stripline characteristics are given below:

Useful frequency range:	MHz	0,1 to 4 000
Equipment size limits (antenna included):	length	1 200 mm
	width	1 200 mm
	height	400 mm

See report in Annex A [1] for more information.

5.2.4.2 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.

5.2.4.3 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**.

5.3 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 stand so that the axis of the equipment which in its normal use is closest to the vertical shall be vertical;

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 person as support.

The simulated person 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: 300,0 ± 5,0 mm;
- sidewall thickness: 5,0 ± 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 person, at the appropriate height for the equipment.

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

5.4 Acoustic coupler

5.4.1 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 (see Annex A, [3]).

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.

5.4.2 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, see Annex A, [3].

5.4.3 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.

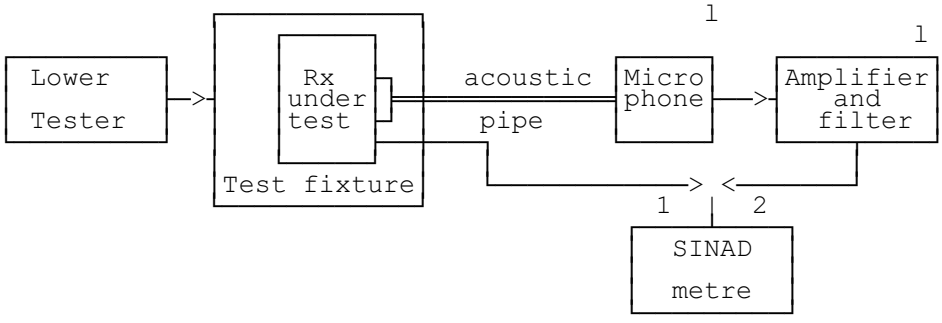


Figure 7: Calibration of the acoustic coupler

5.4.3.1 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. The RF output of the Lower Tester shall be connected to the receiver input (or to the **test fixture** input). The Lower Tester shall be at the DECT RF channel of the receiver and shall be modulated at its test audio input with a 1 kHz tone;

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 equivalent SINAD 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.

5.5 Test antenna of the LT

When the test site is used for radiation measurements the test antenna is used for reception of 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 a 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.

5.6 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 isotopic radiator.

5.7 Test fixture

5.7.1 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. Measurements may only be performed 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; and

2) interfaces to other relevant inputs and outputs.

The test fixture normally shall be provided by the manufacturer.

The performance characteristics of the test fixture shall be approved by the test authority and shall conform to the following basic parameters:

a) the coupling loss shall not be greater than 20 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 Voltage Standing Wave Ratio (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.

5.7.1.1 Calibration of the test fixture for the measurement of transmitter characteristics

The calibration of the test fixture establishes a relationship between the output of the test fixture and the output of the equipment inside the test fixture.

The calibration is valid only at a given frequency or range of frequencies and for a given polarisation of the reference field.

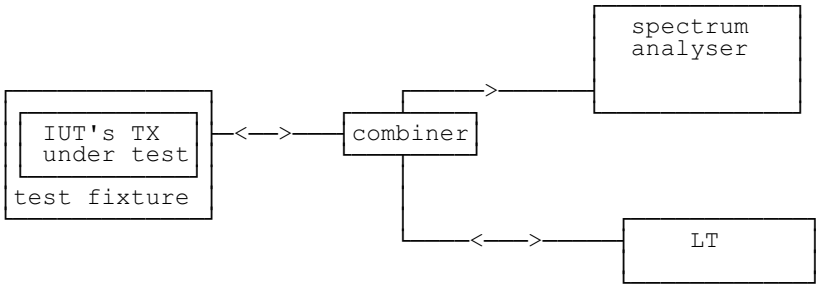


Figure 8: Measuring arrangement for calibration

a) Using the appropriate method described in subclauses 10.2 and 10.3 measure the Normal Transmitted Power (NTP) and note the value of this power and the polarisation used;

b) the transmitter is now placed in the test fixture which is connected to the spectrum analyser. The measured level in dBm shall be noted;

c) the calibration for the test fixture is the linear relationship between the measured power in dBm according to subclauses 10.2 and 10.3 and the measured power in dBm in this calibration set-up.

5.7.1.2 Calibration of the test fixture for the measurement of receiver characteristics

The calibration of the test fixture establishes a relationship between the level of the signal connected to the test fixture 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.

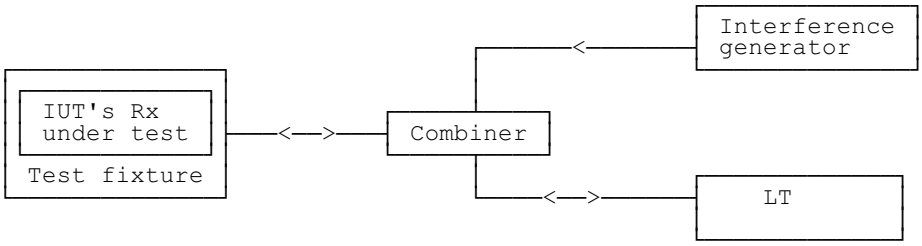


Figure 9: Measuring arrangement for calibration

a) Using the method described in Annex B of this I-ETS, measure the sensitivity expressed as field strength for a bit error ratio of 0,001 or less 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 LT (with bit-error measuring test facilities). The level of the signal connected to the test fixture producing the same bit error ratio measured according to the method used in step a) shall be noted;

c) the calibration of the test fixture is thus the linear relationship between field strength in dBµV/m and the signal generator level in dBµV electro-motive force (emf).

5.7.1.3 Mode of use

A test fixture may be used for tests under extreme temperatures and for transmitter and receiver measurements that can be carried out with an uncalibrated test fixture.

If the calibrated test fixture is used as an alternative for the test site then its use, the characteristics and the calibration shall be mentioned in the test report.

5.7.2 Equipment with a temporary or internal permanent antenna connector

The means to access and/or implement the internal permanent or temporary antenna connector shall be stated by the manufacturer with the aid of a diagram.

The fact that use has been made of the internal antenna connection to facilitate measurements shall be recorded in the test report.

5.7.2.1 Equipment with a temporary antenna connector

The manufacturer, or an authorised representative, may submit one set of equipment with the normal antenna connected, to enable the radiated measurements to be made.

The manufacturer, or an authorised representative, shall attend the test laboratory at conclusion of the radiated measurements, to disconnect the antenna and fit the temporary connector.

The test laboratory staff shall not connect or disconnect any temporary antenna connector.

Alternatively the manufacturer, or an authorised representative, may submit two sets of equipment to the test laboratory, one fitted with a temporary antenna connector with the antenna disconnected and the other with the antenna connected.

Each equipment shall be used for the appropriate tests.

5.8 Indoor test site

An indoor test site may be used instead of an open air test site or an anechoic room. However, the open air test site and the anechoic room are preferred. Each test case lists the allowed test sites.

5.8.1 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 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 site arrangement is shown in figure 10 for horizontal polarisation.

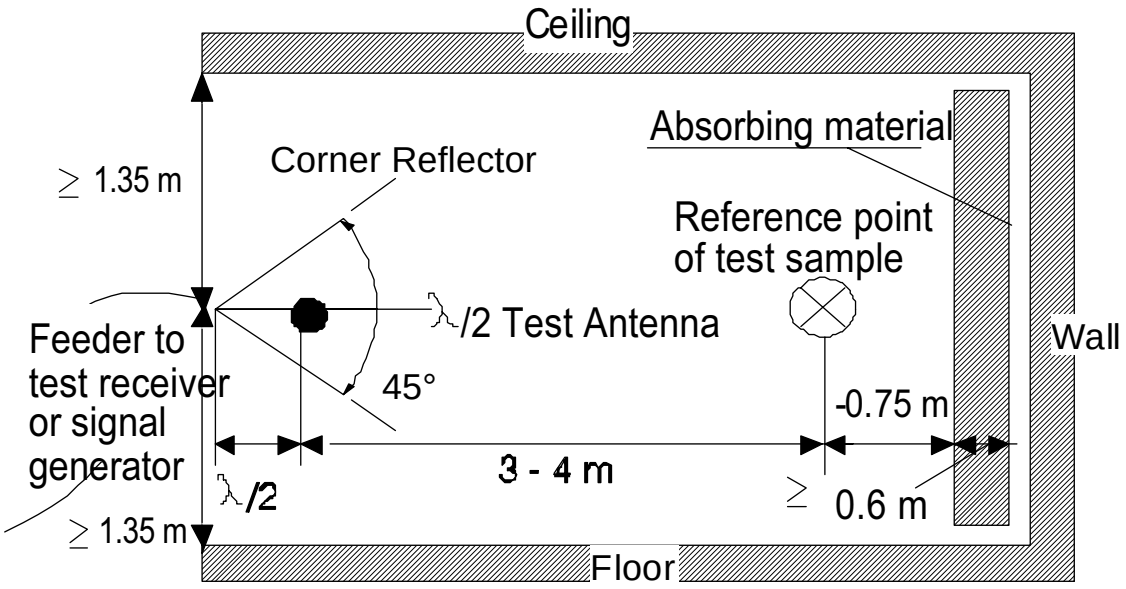


Figure 10: Indoor test site arrangement (shown for horizontal position)

The potential reflections from the wall behind the equipment under test are reduced by placing a barrier of absorbent material in front of the wall. 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. 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 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.

5.8.2 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.

5.8.3 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.

5.9 Lower Tester (LT)

5.9.1 Description

The lower tester is a logical grouping that contains a DECT PT, DECT FT, the measurement equipment and the controller of the DECT testing system. The LT has the job of sending testing commands, performing calculations (e.g. signal processing) and interacting with the IUT for the various tests. The LT shall implement the mandatory parts of the DECT specification including the optional parts of the PAP. This unit is also involved with DECT RF carrier generation, reception, and demodulation. In addition, the LT has wideband RF requirements for emissions and interference testing.

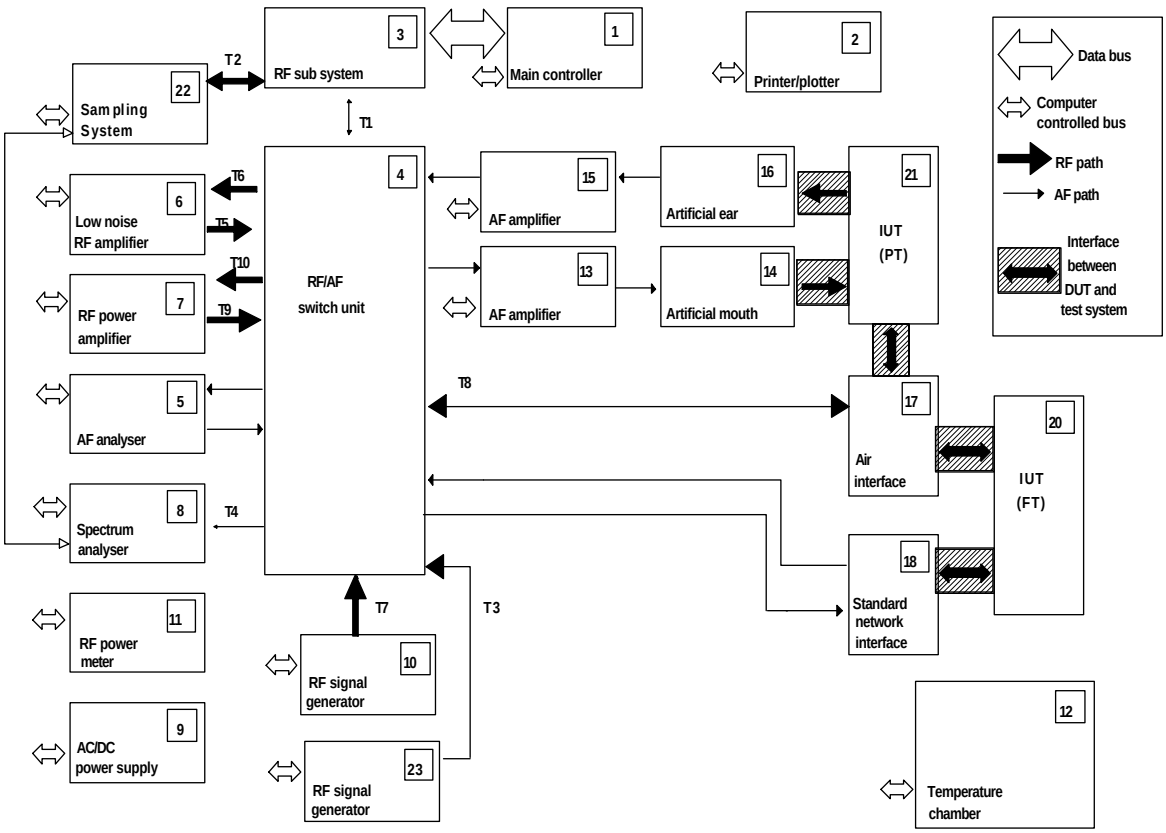


Figure 11: Contents of the LT

5.9.2 Connections between the IUT and the LT

This is specified in each test case.

5.9.3 Functions and abilities

The LT shall include all the functions necessary to perform the tests described in this document.

These include the ability to:

- generate one actual DECT RF signal;
- generate one DECT-like RF signal;
- generate CW interferer(s);
- sample and store an accurate representation of the IUT's RF signal;
- transmit a variety of test data sequences in the B-field;
- transmit on more than one slot per frame;
- make measurements as described in this document according to the uncertainties described in subclause 5.9.5;
- emulate a DECT FT;
- emulate a DECT PT.

5.9.4 Signal generation uncertainty

5.9.4.1 Interfering DECT-like RF signals

Carrier frequency: ± 5 kHz.

This is a RF carrier using gaussian shaped frequency-shift keying (Bandwidth Time (BT) = 0,5) modulated with a 1 152 kbit/s pseudo-random sequence with minimum length 2^9-1. The power levels and burst timings of this carrier shall conform to the limits specified in ETS 300 175-2 [2]. It is not required that this interferer be slot synchronised to the DECT test signal generated by the LT.

5.9.4.2 CW interferers

Uncertainty determined by the overall bit error rate measurement uncertainty of a test case. This is specified in subclause 5.9.5.

5.9.4.3 Test modulation signals

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 data (bit stream):

***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 pseudo-random bit sequence of at least 511 bits in accordance with CCITT Recommendation O.153 [31]. This sequence shall be continuously repeated. This signal is used as a wanted signal.

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.

5.9.5 Measurement uncertainty

The following values of measurement uncertainty associated with each measurement parameter apply to all of the test cases described in this I-ETS.

5.9.5.1 RF measurements

Absolute radio frequency:	± 10 kHz
Relative radio frequency:	± 1 kHz
Relative radio frequency for transmit frequency drift test:	≤ 250 Hz
Conducted emissions:	± 1 dB
Radiated emissions:	± 3 dB
Maximum frequency deviation:	5 kHz
Absolute RF power (via an antenna connector):	± 1 dB
Absolute RF power (for unwanted emissions in the DECT band):	± 4 dB
Absolute RF power (for unwanted emissions outside the DECT band):	
conducted:	± 4 dB
radiated:	± 6 dB
Relative RF power:	± 1 dB
Absolute RF power (radiated):	± 3 dB
Bit to bit jitter:	≤ ± 0,01 µs
Packet timing:	≤ ± 0,1 µs
Timing stability of FT:	1 ppm
Bit error rate:	± 5 %
Transmitter burst transient time:	% 20 (of the measured value)

NOTE: All figures reflect a 95 % confidence level.

5.9.5.2 Speech and telephony tests

Unless otherwise specified, the measurement uncertainty associated with the tests specified in Clause 15 shall be:

Electrical signal power	± 0,2 dB for levels ≥ - 50 dBm
Electrical signal power	± 0,4 dB for levels < - 50 dBm
Sound pressure	± 0,6 dB
Time	± 5 %
Frequency	± 2 %

- or better.

NOTE: When measuring sampled systems, it is advisable to avoid measuring at multiples of the sampling frequency. There is a tolerance of ± 2 % on the frequencies, which may be used to avoid this problem, except for 4 kHz where only the - 2 % tolerance may be used.

5.10 Upper Tester (UT)

5.10.1 Description of the UT

The upper tester is part of, but not necessarily restricted to, the IUT. For the purpose of testing, an IUT capable of transmitting must recognise a mandatory set of test commands sent by the LT. The ability to recognise and implement these commands is contained in the UT which is resident in the medium access control layer as described in ETS 300 175-3 [3]. All DECT equipment shall be capable of recognising these commands.

5.10.2 The test standby mode

Accessibility to these messages is controlled by some means of mechanical interlocking method (e.g. dip-switch, jumper, prom, or key-pad code as designated by the manufacturer) to prevent accidental execution of these messages in a DECT user environment.

When the IUT has been switched into a mode whereby the test messages are accessible, the IUT is said to be in the test standby mode.

5.10.3 Test messages

The MAC layer test messages provide the following functions:

a) instructs the IUT to transmit on a LT-specified physical channel. The test message also determines whether the handover function of the IUT (if so equipped) is disabled and if previous bearers are to be maintained. See subclauses 7.2.5.4.2 and 12.3 of ETS 300 175-3 [3];

b) instructs the IUT to perform the loopback function in which a test data pattern transmitted by the LT is replicated in the reply transmission of the IUT. The test data pattern is a bit sequence located in the D-fields of the LT and IUT. The bits of the D-field that are affected by the loopback function depends on the equipment type and are as follows:

Equipment type	Loopback Bits
Transmits only A-field:	a_{16} to a_{47}
Transmits half-slots:	b_0 to b_{79}
Transmits full-slots:	b_0 to b_{319}
Transmits double-slots:	b_0 to b_{799}

NOTE: Equipment capable of transmitting more than one slot type shall use the longest slot type for this test message.

See subclauses 7.2.5.4.3 and 12.4 of ETS 300 175-3 [3];

c) defeats antenna diversity and select the specified antenna for operation in those IUTs possessing antenna diversity. See subclauses 7.2.5.4.4 and 12.5 of ETS 300 175-3 [3];

d) initiates the bearer handover procedure resident in an IUT that is declared by the manufacturer as possessing bearer handover capability. See subclauses 7.2.5.4.5 and 12.6 of ETS 300 175-3 [3];

e) permits inclusion of proprietary test messages by means of the "escape" code. See subclauses 7.2.5.4.6 and 12.8 of ETS 300 175-3 [3];

f) provides for a means to reset the test state of the IUT by means of the 'clear test modes' message. See subclauses 7.2.5.4.8 and 12.9 of ETS 300 175-3 [3].

5.11 Description of a reference FT and PT

The reference FT and PT are systems consisting of the RF equipment, controller(s), software, and other related components necessary to be capable of implementing all the functions defined in the DECT specification documents. The reference FT and PT will typically be a subset of the DECT testing system.

5.12 General test methods

It is recognised that for some parameters alternative test methods may exist. All alternative test methods are subject to accreditation and thus shall be fully documented and the appropriate measurement uncertainty calculations performed. No alternative method shall be used which has not been accepted by the Accreditation Body.

5.12.1 Sampling the RF signal

5.12.1.1 Introduction

A number of tests in this document require the RF signal to be sampled and demodulated. The following text describes the sampling method that should be performed in the LT.

5.12.1.2 Sampling method

The equipment under test is connected to the lower tester. This connection will be direct for an IUT having an antenna connector or via an antenna coupling device for an IUT with an integral antenna and not having means of connecting an external antenna, unless otherwise specified in this document.

Handover (if available) shall be disabled in the IUT while the sampling takes place. See subclause 5.10.3 for the appropriate test message reference.

Antenna diversity (if available) shall be disabled in the IUT while the sampling takes place. See subclause 5.10.3 for the appropriate test message reference.

Using a sampling measurement method, capture a representation of the IUT's transmitted RF signal. The position in a physical packet shall be calculated using the samples from the physical packet, knowing the received bit pattern. These calculated bit positions shall be used as the time reference when making measurements of RF frequency, phase and power.

NOTE: When reference is made to b0 in this I-ETS, for example, it is intended that its position is calculated using many samples of a physical packet. The frequency, power or phase at this theoretical position of b0 can then be measured.

5.12.2 Test arrangement for interference testing

For interference testing, ETR 043 [10] specifies a minimum operating distance for the various types of DECT equipment. The following subclauses describes the test arrangements inside an anechoic chamber required in order to test compliance of the IUT with the minimum distance requirements.

5.12.2.1 PT to PT arrangement

In the PT to PT situation, the minimum distance for non-interference operation is specified as being 0,5 metre. The diagram below shows the testing arrangement:

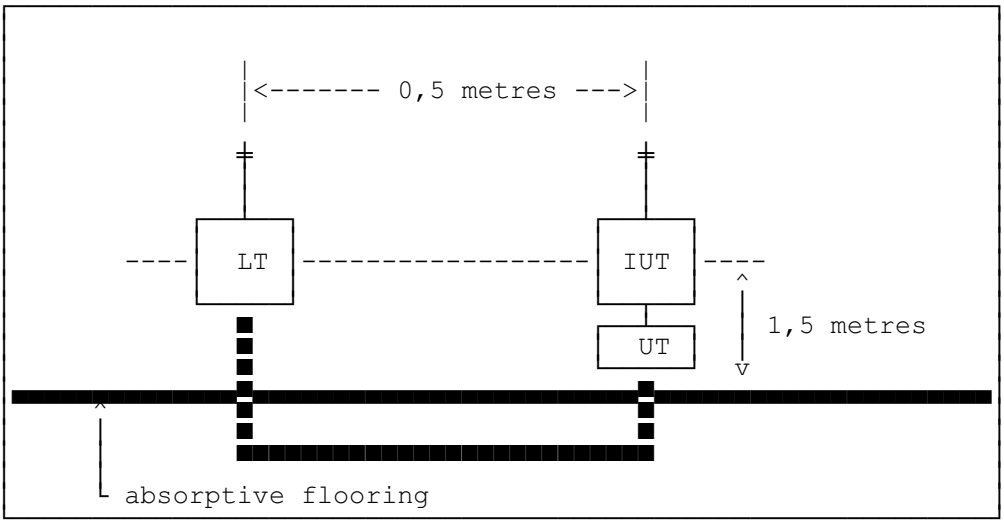


Figure 12

The elevation of the antennas are the same. Absorptive flooring is used to minimise reflection effects. The link between the UT and the IUT indicates the control of the IUT via the DECT air interface.

5.12.2.2 FT to FT arrangement

In the FT to FT situation, the minimum distance for non-interference operation is specified as being 1,0 metre. The diagram below shows the testing arrangement:

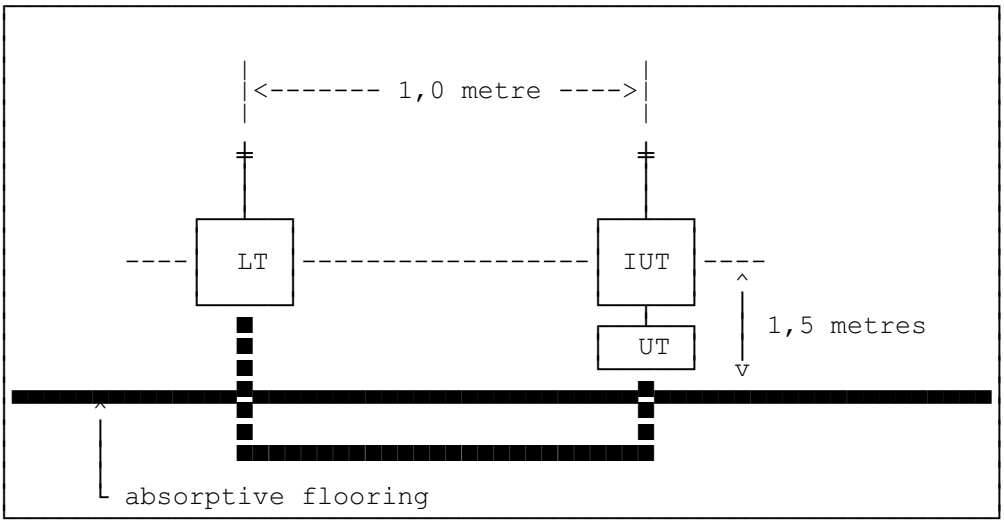


Figure 13

The elevation of the antennas are the same. Absorptive flooring is used to minimise reflection effects. The link between the UT and the IUT indicates the control of the IUT via the DECT air interface.

5.12.2.3 FT to PT arrangement

In the FT to PT situation, the minimum distance for non-interference operation is specified as being 1,0 metre. The diagram below shows the testing arrangement:

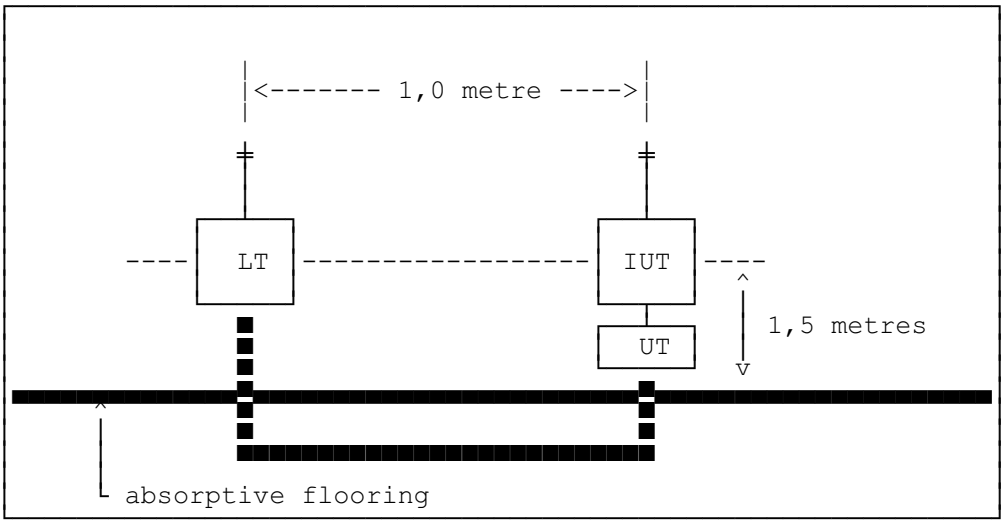


Figure 14

The elevation of the antennas are the same. Absorptive flooring is used to minimise reflection effects. The link between the UT and the IUT indicates the control of the IUT via the DECT air interface.

5.12.3 Determining the reference position

During many tests the IUT is required to be oriented specifically in relation to the test antenna connected to the LT.

This position is called the reference position and is defined in the following paragraphs.

5.12.3.1 Case 1: IUTs that cannot transmit

If the IUT has only an integral antenna then the manufacturer shall inform the test authority of the orientation of the integral antenna.

The IUT shall then be rotated in both horizontal and vertical planes in order to provide the maximum theoretical field strength at the test antenna if the integral antenna were transmitting. This orientation shall be called the reference position.

5.12.3.2 Case 2: IUTs that can transmit

The IUT shall be placed in a mode whereby it is transmitting.

NOTE: For most tests the IUT will have already been placed in a transmission mode.

The IUT shall be rotated in both horizontal and vertical planes in order to locate the direction of maximum field strength that is detected by the test antenna. This orientation shall be called the reference position.

5.13 Test set-up

Test set-ups have been defined according to ISO Publication 9646 [13]. The test cases listed in table 6 have an associated test set-up.

The numbers inside the figures shown in subclauses 5.13.1 to 5.13.5 refer to functional blocks inside the LT. These are shown in figure 11 in subclause 5.9.1.

5.13.1 Test set-up 1

For the test set-up depicted in figure 15, the following test cases apply:

Test cases: 1, 2, 3, 4, 5, 6, 7, 8, 14, and 15.

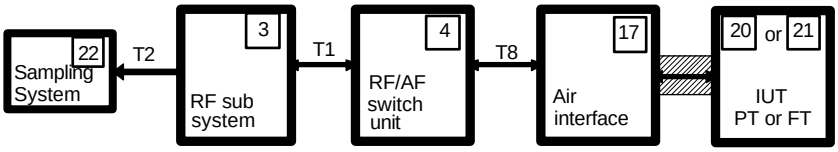


Figure 15: Test set-up 1

5.13.2 Test set-up 2

For the test set-up depicted in figure 16, the following test cases apply:

Test cases: 16 and 18.

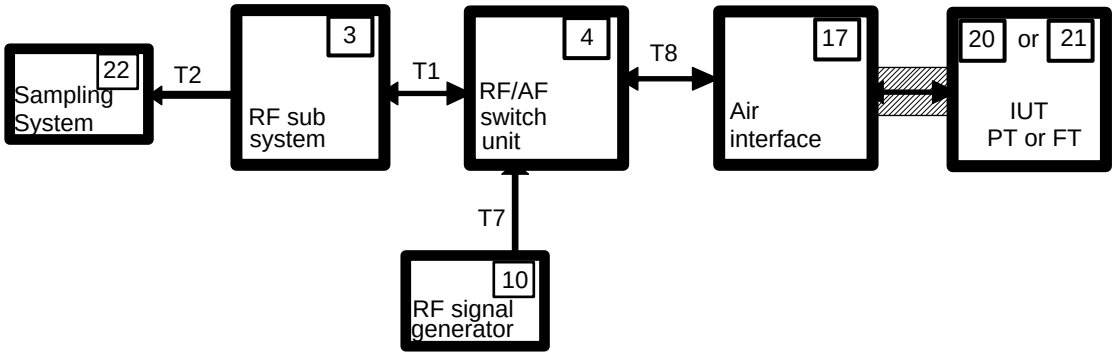


Figure 16: Test set-up 2

5.13.3 Test set-up 3

For the test set-up depicted in figure 17, the following test case applies:

Test case: 19.

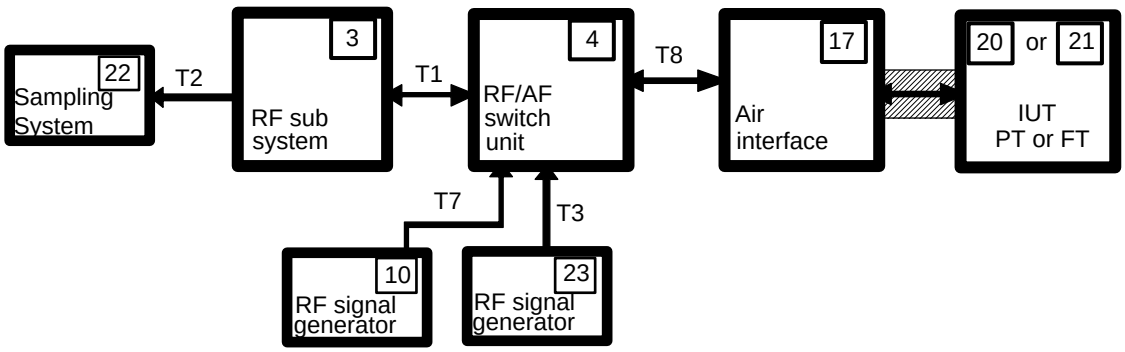


Figure 17: Test set-up 3

5.13.4 Test set-up 4

For the test set-up depicted in figure 18, the following test cases apply:

Test cases: 9, 10, 11, 12, 13, and 20.

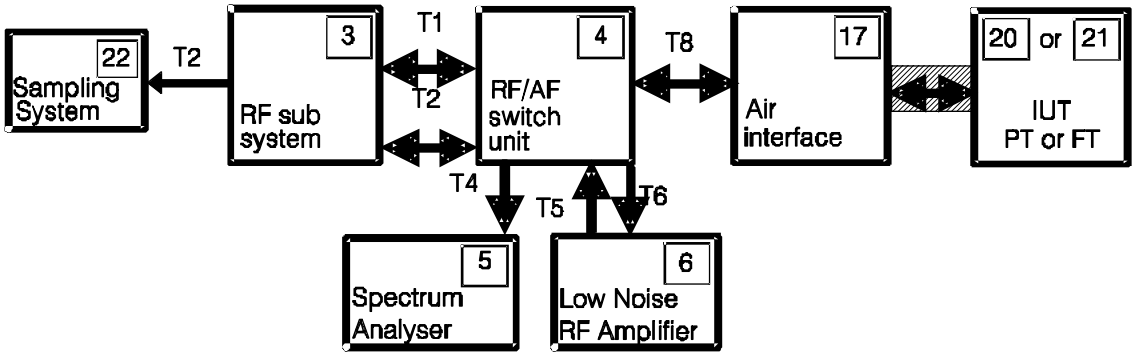


Figure 18: Test set-up 4

5.13.5 Test set-up 5

For the test set-up depicted in figure 19, the following test case applies:

Test case: 17.

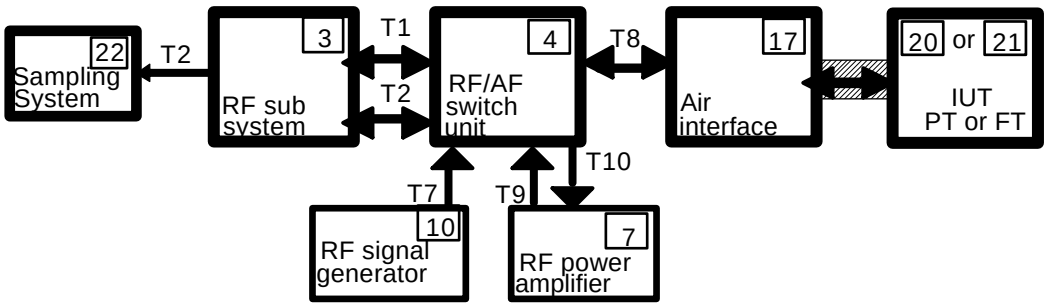


Figure 19: Test set-up 5

6 Test conditions, power sources and ambient temperatures

6.1 General

The following conditions apply during all tests:

Temperature uncertainty: ± 1 °C
Atmospheric pressure: 86 to 106 kPa
Relative humidity: 20 % to 75 % non-condensing
Humidity uncertainty: ± 10 %

The temperature conditions and voltage supply applied in each test are specified as either nominal or extreme. The definitions of nominal and extreme are contained in subclauses 6.2 and 6.3 and each test case defines whether nominal or extreme conditions apply. In some test cases only extreme temperature conditions apply and this is stated in the appropriate test case.

Before measurements are made, the equipment shall have reached thermal equilibrium in the test chamber. The equipment shall be switched off during the temperature stabilising period. If the thermal balance is not checked by measurements, a temperature stabilizing period of at least one hour, or such period as may be decided by the test authority, shall be allowed.

Before the start of a test, but after reaching thermal equilibrium in the test chamber, the equipment shall be powered up. For RFPs, the time between power-up and the start of testing shall be greater than 15 minutes. For PPs, testing may commence any time after 1 minute after power-up.

The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled, so that condensation does not occur.

It should be noted that when it is impractical to carry out the tests under these conditions, a statement giving the actual temperature and relative humidity during the tests shall be added to the test report.

6.2 Nominal test conditions

These are identical for all types and classes of equipment. This is clarified by the following three figures.

PP

	VOLTAGE MIN	NOM	MAX
0°			
+15-35°		■■■	
+40°			

Figure 20

FP, RFP, CCFP for Class E1 use

	VOLTAGE MIN	NOM	MAX
+10°			
+15-35°		■■■	
+40°			

Figure 21

FP, RFP, CCFP for Class E2 use

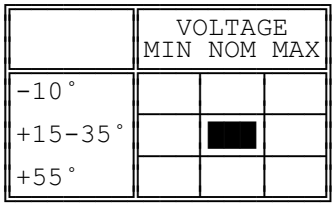


Figure 22

NOTE: For nominal temperature, each measurement is made at the temperature of the test site, which shall be within + 15 °C to + 35 °C.

6.3 Extreme test conditions

The extreme test conditions are determined by the type of equipment under test. The following three figures class the IUT as either PP, FP, RFP or CCFP. See Clause 3 for definitions.

In addition, FPs, RFPs and CCFPs shall be classed as either for Class E1 use or Class E2 use. Class E1 use refers to indoor areas allowing for personal comfort, for example, homes, offices, laboratories or workshops. Class 2 use refers to all other areas.

NOTE: For the extreme temperature ranges of - 10 °C, 0 °C, 10 °C and 40 °C, measurements shall be made at the specified temperature with a tolerance of ± 1 °C.

The definitions of minimum, nominal and maximum applied voltage are contained in subclauses 6.5 and 6.6.

PP

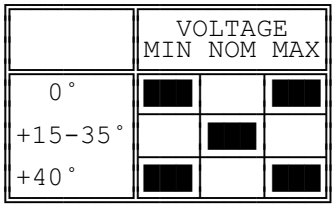


Figure 23

FP, RFP, CCFP for Class E1 use

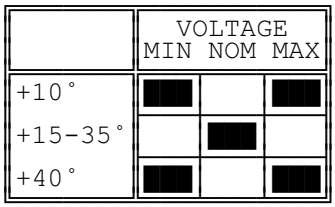


Figure 24

FP, RFP, CCFP for Class E2 use

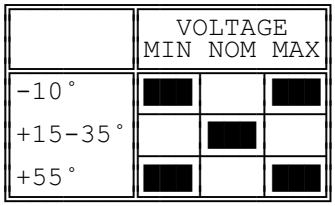


Figure 25

6.4 Test power source - general requirements

During the 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 subclauses 6.5 and 6.6. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the test purposes, 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 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 is practical. In each case connections must be made readily available by the manufacturer.

During tests, the power source voltages shall be maintained within a tolerance of ± 3 % relative to the voltage at the beginning of each test.

6.5 Nominal test power source

6.5.1 Mains voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of this specification, the nominal voltage shall be the voltage or voltages for which the equipment was designed as declared by the manufacturer. The frequency of the test power source corresponding to the AC mains shall be between 49 and 51 Hz.

6.5.2 Regulated lead acid battery power sources

When the radio equipment is intended for operation from a lead-acid chemistry battery source, the source voltage used during testing shall be 1,1 times the nominal voltage of the battery (i.e. 1,1 ^{x} number of cells ^{x} 2V/cell).

6.5.3 Nickel cadmium battery

When the equipment is intended for operation from a nickel-cadmium chemistry battery source, the source voltage used during testing shall be the nominal voltage of the battery (1,2 volt per cell).

6.5.4 Other power sources

For operation from other power sources or types of battery, either primary or secondary, the normal test source voltage shall be that declared by the equipment manufacturer.

6.6 Extreme test power source

6.6.1 Mains voltage

The extreme test source voltages for equipment to be connected to an AC mains source shall be the nominal mains voltage ± 10 %. The frequency of the test power source shall be between 49 and 51 Hz.

6.6.2 Regulated lead acid battery power sources

When the equipment is intended for operation from the usual type of regulated lead acid battery source, the extreme test voltages shall be 1,3 and 0,9 times the nominal voltage of the battery.

6.6.3 Nickel cadmium battery

When the equipment is intended for operation from the usual type of nickel cadmium battery, the extreme test voltages shall be 1,25 and 0,9 times the nominal voltage of the battery.

6.6.4 Other power sources

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

1) for Leclanché type of battery - 0,85 times the nominal voltage;

2) for other types of primary battery - 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, or designed for operation within extreme voltage limits not in accordance with those quoted above the extreme test voltages shall be those agreed between the equipment manufacturer and the test authority and shall be recorded with the test results.

7 Accuracy and stability of RF carriers

See subclause 4.1.2 of ETS 300 175-2 [2].

7.1 Definition

The ten RF carriers allocated to the DECT service are given by:

Fc = F0 - c x 1 728 kHz, c = 0, 1, ..., 9;

where F0 = 1 897,344 MHz.

7.2 Test environment

The test shall take place at a test site or in a test fixture.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under extreme test conditions.

7.3 Method of measurement

a) The LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

   NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

b) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

c) the Lower Tester (LT) shall transmit a packet with a test sequence in the loopback field of the packet. This test sequence shall be such that the sequence 0000111100001111.... is transmitted at the antenna of the IUT in the loopback field of the reply packet;

   NOTE: DECT equipment complying with the Public Access Profile (PAP) will have the scrambling operation as specified in ETS 300 175-3 [3], Annex E, in operation. Consequently, the test sequence will be scrambled twice (once in the TBC of the LT and once in the TBC of the IUT before being transmitted by the IUT) requiring pre-scrambling of the test sequence.

d) using the sampling method described in subclause 5.12.12 of this document, capture a representation of the IUT's transmitted RF signal after allowing the IUT to be in an active-locked state (see ETS 300 175-3 [3]) for more than 1 s;

e) the IUT's carrier frequency shall be assumed to be the average of the measured absolute frequencies of the loopback bits;

f) parts c) to e) shall be repeated until the following number of measurements have been made:

Equipment type	Number of measurements
A-field only transmit	100
Half-slot transmit	40
Full-slot transmit	10
Double-slot transmit	5

The center frequency of the IUT is taken to be the mean value of the measurements;

g) parts c) to f) shall be repeated for all combinations of temperatures and power supply voltages allowed under extreme test conditions;

h) parts c) to g) shall be repeated for all DECT carrier frequencies;

i) when the IUT is a PP, then parts c) to h) shall be repeated, with the addition that the RF signal is sampled (in part d)) during the first 1 s of the IUT going into a transmit mode from a non-transmitting mode.

7.4 Verdict criteria when the IUT is a RFP

The carrier frequencies as measured shall be within ± 50 kHz of the appropriate nominal DECT carrier frequency F_c.

7.5 Verdict criteria when the IUT is a PP

7.5.1 Case 1: when the measurement is made during the first 1 s of the IUT going into a transmit mode from a non-transmitting mode

The carrier frequencies as measured either relative to an absolute frequency reference or relative to the received carrier, shall be within ± 100 kHz of the nominal DECT carrier frequency F_c.

7.5.2 Case 2: When the measurement is made at any other time

The carrier frequencies as measured either relative to an absolute frequency reference or relative to the received carrier, shall be within ± 50 kHz of the nominal DECT carrier frequency F_c.

8 Accuracy and stability of timing parameters

See subclauses 4.2.2, 4.2.3 and 4.2.4 of ETS 300 175-2 [2].

8.1 Slot structure definitions

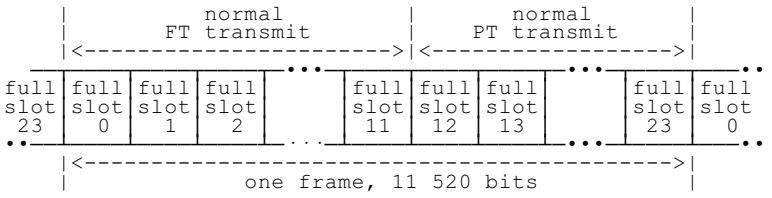


Figure 26: Frame and full-slot structure

Full-slots "K" are numbered from 0 to 23, and half-slots "L" are numbered 0 or 1, where half-slot 0 occurs earlier than half-slot 1. Normally full-slots K = 0 to 11 are used in the FT to PT direction, while full slots K = 12 to 23 are normally used in the PT to FT direction.

Each full-slot has a duration of 480 bit intervals. Bit intervals within a full-slot are denoted f0 to f479 where interval f0 occurs earlier than interval f1. Each half-slot has a duration of 240 bit intervals. Half-slots commence at f0 or f240. See figure 27.

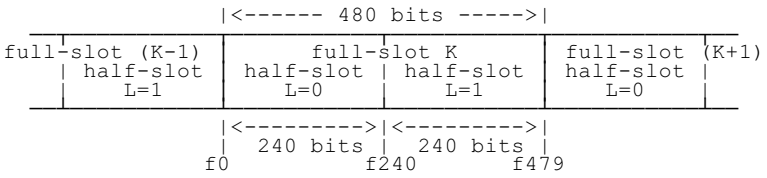


Figure 27: Half-slot format

Each double slot has a duration of 960 bit intervals. Bit intervals within a double slot are denoted f0 to f959. Bits f0 to f479 coincide with the same notation for full slots with even K, K(e).

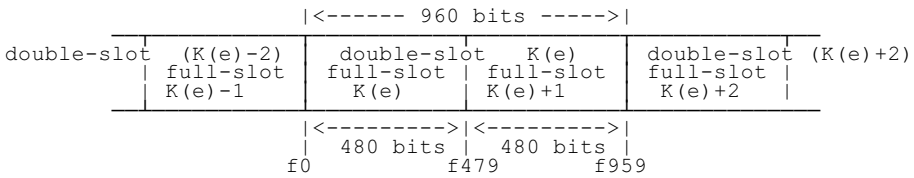


Figure 28: Double slot format

8.2 Definition of the position of b0

The start of bit b0 is defined to occur at the point in time one bit period prior to the reversal of the first frequency excursion of the transmitter that exceeds the minimum deviation as stipulated in ETS 300 175-2 [2]. It is not the point at which a receiver determines the presence of b0.

8.3 Measurement of packet timing jitter

8.3.1 Test environment

The test shall take place at a test site in a test fixture. If the IUT is equipped with a temporary connector, the temporary connector may be used in place of the test fixture for this test.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under extreme test conditions.

8.3.2 Method of measurement

a) The LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE 1: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

NOTE 2: The manufacturer shall declare to the testing authority the time required for system synchronisation by the IUT.

b) the LT shall place the IUT in a mode whereby the IUT is transmitting on all the slots in a frame that it is capable of in normal operation;

NOTE: The manufacturer shall declare to the testing authority the maximum number of transmissions per frame the IUT is capable of.

c) using a sampling method, capture a representation of the RF signal transmitted by the IUT on the same slot position in 2 consecutive frames;

d) the LT shall determine the positions of b0 in the slots that were sampled in part c) above;

e) parts c) and d) shall be repeated 1 000 times;

f) the reference time is the mean of the values measured in parts c) through e). The deviation of the maximum and minimum values from the mean is the packet timing jitter.

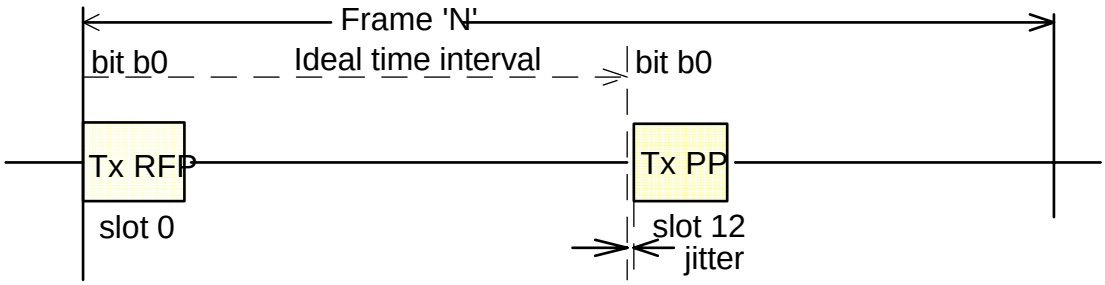


Figure 29

8.3.3 Verdict criteria

The packet timing jitter, as measured, shall be less than ± 1 µs for the duration of this test.

8.4 Measurement of timing jitter from bit-to-bit in the same slot on the same channel

8.4.1 Test environment

The test shall take place at a test site or in a test fixture. If the IUT is equipped with a temporary connector, the temporary connector may be used in place of the test fixture for this test.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT. The test shall take place under extreme test conditions.

8.4.2 Method of measurement

a) The LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

b) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

c) the Lower Tester (LT) shall transmit a pre-scrambled test sequence. This pre-scrambled test sequence shall be such that the sequence 0000111100001111.... is transmitted by the IUT.

NOTE: DECT equipment complying with the Public Access Profile will have the scrambling operation as specified in ETS 300 175-3 [3], Annex E, in effect. Consequently, the pre-scrambled sequence will be scrambled twice (once in the TBC of the LT and once in the TBC of the IUT before being transmitted by the IUT).

d) using a sampling method, capture a representation of the RF signal transmitted by the IUT for one slot and on one frequency channel;

e) the LT shall determine the jitter of all the bits in the slot as follows:

1) calculate the mean bit period of the slot sampled in part d) above;

2) the ideal bit positions in the slot are determined using the mean bit period from part e), subpart 1) above;

3) the jitter of the bit transitions are the time differences between the ideal bit transitions determined in subpart 2) above and the measured bit transitions.

8.4.3 Verdict criteria

The jitter in the physical packet as measured shall be within ± 0,1 µs.

8.5 Measurement of the reference timing accuracy of a RFP

8.5.1 Test environment

The test shall take place at a test site or in a test fixture. If the IUT is equipped with a temporary connector, the temporary connector may be used in place of the test fixture for this test.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under extreme test conditions.

8.5.2 Method of measurement

a) A minimum of one duplex bearer shall be set-up between the LT and the IUT;

b) the LT shall place the IUT in a mode whereby the IUT is transmitting simultaneously on all the slots in a frame that it is capable of in normal operation;

c) using a sampling method, measure the time, t_{long}, between the transmission of 1 000 frames using the same bit in each slot as the point of reference in each frame.

8.5.3 Verdict criteria

The IUT is required to conform to the following timing accuracies and stabilities at all the applied voltage conditions:

Table 4: Reference timing accuracies and stabilities

Type of IUT	Temperature	
	Nominal	Extreme
Multiple channel RFP	5 ppm	10 ppm
Single channel RFP	No Test	10 ppm

The following table indicates the range of values for t_{long} to which the IUT shall conform.

Table 5: Allowable timing variations

Timing zccuracy and stability (ppm)	Ranges of t_{long} constituting a pass (seconds)
5	9,99995 < t_{long} < 10,00005
10	9,99990 < t_{long} < 10,00010

9 Transmission burst

See subclause 5.2 of ETS 300 175-2 [2].

9.1 Definitions

9.1.1 Physical packets

The term "physical packet" as used in this I-ETS refers to all the bits transmitted by the DECT radio end point in one slot time.

9.1.2 Transmitted power

This is the mean power delivered over one radio frequency cycle.

9.1.3 Normal Transmitted Power (NTP)

The NTP is the transmitted power averaged from the start of bit b0 of the physical packet to the end of the physical packet.

9.1.4 Transmitter attack time

This is the time taken for the transmitted power to increase from 25 µW to the time that the first bit of the physical packet, b0, starts transmission.

The transmitter attack time shall be less than 10 µs.

9.1.5 Transmitter release time

This is the time, taken from the end of the physical packet, for the transmitted power to decrease to 25 µW.

The transmitter release time shall be less than 10 µs.

9.1.6 Minimum power

From the first bit of the packet, b0, to the end of the physical packet, the transmitted power shall be greater than (NTP - 1 dB).

9.1.7 Maximum power

From 10 µs after the start of bit b0 to 10 µs after the end of the physical packet the transmitted power shall be less than (NTP + 1 dB).

From 10 µs before the start of bit b0 to 10 µs after the start of bit b0 the transmitted power shall be less than (NTP + 4 dB).

9.1.8 Maintenance of transmission after packet end

The transmitted power shall be maintained greater than (NTP - 6 dB) for 0,5 µs after the end of the physical packet.

9.1.9 Transmitter idle power output

For the time period starting 27 µs after the end of the physical packet, and finishing 27 µs before the next transmission of data bit b0, the transmitter idle power output shall be less than 20 nW as measured in a 1 MHz measurement bandwidth. This requirement shall apply except when b0 of the next transmitted packet occurs less than 54 µs after the end of the transmitted physical packet.

9.2 Test environment

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal and extreme temperature conditions at the nominal supply voltage.

This test shall take place either at a test site, in an anechoic chamber, or in a test fixture for the nominal temperature condition. The extreme temperature testing shall take place inside a temperature chamber with the IUT mounted in a test fixture.

9.3 Method of measurement

a) The LT shall place the IUT in a mode whereby the IUT is transmitting at a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

   NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

b) using a sampling measurement method, capture a representation of the IUT's transmit burst's amplitude and modulation. See subclause 5.12.12;

c) from the array of samples the LT calculates the position of bit b0 and the end of the physical packet in each sample to an accuracy of 0,1 µs;

d) parts b) and c) are repeated every 1 s for period of 60 s thus giving 60 bursts for measurement;

e) parts a) to d) shall be repeated for the highest and lowest frequency channel on which the IUT can transmit.

9.4 Verdict criteria

The array of power samples shall be compared for a fit within the power-time template as shown in figure 30.

The sampled bursts, as measured, shall conform to the power-time template.

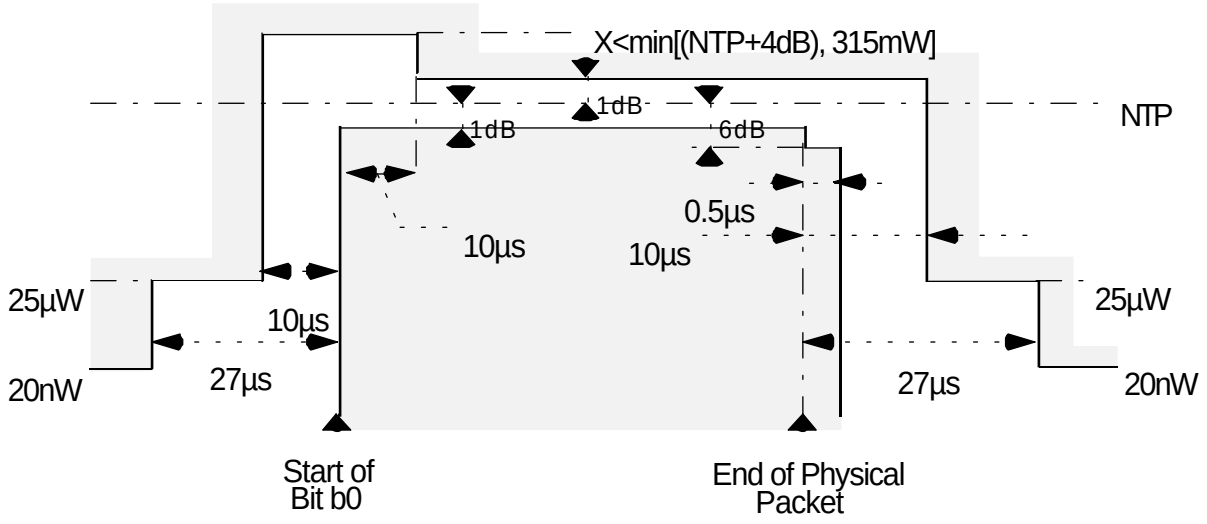


Figure 30: Power-time template

NOTE: As described in subclause 9.1.9, the 20 nW power envelope shown in figure 30 is only applicable when the time between the end of a physical packet and the transmission of b0 of the next physical packet is greater than 54 µs.

10 Transmitted power

See subclause 5.3 of ETS 300 175-2 [2].

10.1 Definitions

10.1.1 PP and RFP with an integral antenna

The equivalent isotropically radiated NTP shall be less than 250 mW per simultaneously active transceiver.

10.1.2 PP and RFP with external connections for all antennas

For a radio endpoint with more than one antenna port, the instantaneous power from each of antenna port shall be added together to give the NTP.

The NTP shall be less than 250 mW per simultaneously active transceiver.

10.1.3 PP and RFP with both integral and external antennas

If the integral and external antennas are not transmitting simultaneously then the test cases described in subclauses 10.2 and 10.3 shall be applied independently. The appropriate antenna is selected using the test message referenced in subclause 5.10.3.

If the integral and external antennas are transmitting simultaneously then the following test steps shall be applied:

a) attach the external antenna(s) intended for normal use to the antenna connector(s);

b) perform the test case as described in subclause 10.2.

10.2 PP and RFP with an integral antenna

10.2.1 Test environment

The test shall take place under nominal temperature conditions and at a nominal supply voltage.

This test shall take place either at a test site or in an anechoic chamber for the nominal temperature condition. The extreme temperature testing shall take place inside a temperature chamber with the IUT mounted in a test fixture.

10.2.2 Method of measurement

a) If the IUT incorporates antenna diversity, then the LT shall command the IUT to operate on a single antenna. See subclause 5.10.3 for the appropriate test message reference;

b) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

   NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

c) a test antenna with a good directivity to limit reflections is connected to a calibrated receiver. The manufacturer shall indicate the polarisation of the integral antenna so that the test antenna can be set to the same polarisation as the integral antenna of the IUT throughout this test. The test antenna shall be raised or lowered until a maximum received signal is obtained;

   NOTE: The IUT shall be orientated in the reference position using the procedure described in subclause 5.12.3.

d) at this position, the LT shall:

   d_1) use the sampling method described in subclause 5.12.1.2 of this document to capture a representation of a physical packet transmitted by the IUT;

   d_2) determine the position of b0 in the physical packet and the end of the physical packet;

   d_3) make a measurement of the received power over the 1 MHz bandwidth centred on the DECT RF channel. This power shall be averaged from the start of bit b0 to the end of the physical packet. This measurement shall be called P_R.

e) the substitution antenna shall replace the IUT's transmitter antenna in the same position and polarisation. The frequency of the signal generator shall be adjusted to the IUT's nominal channel frequency on which it was transmitting. The test antenna shall be raised or lowered as necessary to ensure that the maximum signal level is received. The input signal level to the substitution antenna shall be adjusted until an equal or a known related level to P_R is obtained in the test receiver.

   P_T is equal to the power supplied by the signal generator, increased by the known related level 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.

   The equivalent isotropically radiated NTP is assumed to be equal to P_T;

f) parts b) to e) shall be performed for RF channels c = 0, 5, and 9.

10.2.3 Verdict criteria for all IUTs

The NTP per simultaneously active transceiver, as measured, shall be less than 250 mW plus the maximum allowable measurement uncertainty as given in subclause 10.2.3.

10.2.4 Verdict criteria for IUTs with the Public Access Profile (PAP)

The IUT shall comply with the verdict criteria in subclause 10.2.3 and it's NTP, as measured, shall be greater than 80 mW per simultaneously active transceiver at both nominal and extreme temperatures.

10.2.5 Declaration for IUTs with the public access profile

The applicant shall confirm by declaration that the adopted nominal design NTP is 170 mW.

10.3 PP and RFP with external antenna connection(s)

10.3.1 Test environment

The test shall take place under extreme temperature conditions and at a nominal supply voltage.

This test shall take place either at a test site or in an anechoic chamber for the nominal temperature condition. The extreme temperature testing shall take place inside a temperature chamber.

The IUT shall be connected to the LT via the antenna connector(s).

10.3.2 Method of measurement

a) If the IUT incorporates antenna diversity, then the LT shall command the IUT to operate on a single external antenna. See subclause 5.10.3 for the appropriate test message reference;

b) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

   NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

c) a test load shall be connected to each antenna connector;

d) The LT shall:

   d_1) use the sampling method described in subclause 5.12.1.2 of this I-ETS to capture a representation of a physical packet transmitted by one of the antenna connectors of the IUT into the test load;

   d_2) determine the position of b0 in the physical packet and the end of the physical packet;.

   d_3) make a measurement of the power over the 1 MHz bandwidth centred on the DECT RF channel. This power shall be the power delivered to each load simultaneously, averaging from the start of bit b0 of the physical packet, to the end of the physical packet that was sampled in d_1).

e) parts b) to d) shall be performed for RF channels c = 0, 5, and 9.

When there is more than one antenna port, the instantaneous power from each antenna port shall be added together. The sum shall be called the NTP.

10.3.3 Verdict criteria for all IUTs

The NTP per simultaneously active transceiver, as measured, shall be less than 250 mW.

10.3.4 Verdict criteria for IUTs with the public access profile

The IUT shall comply with the verdict criteria in subclause 10.3.3 and it's NTP, as measured, shall be greater than 80 mW per simultaneously active transceiver.

11 RF carrier modulation

See subclause 5.4 of ETS 300 175-2 [2].

11.1 Test environment

The test should preferably take place at a test site, otherwise a test fixture or temporary connector shall be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

11.2 Method of measurement, parts 1 and 2

The measurement period of a single positive or negative deviation measurement shall begin one bit time after a 0 to 1 or a 1 to 0 transition in the test data pattern. The measurement period shall end one bit time before the next 0 to 1 or 1 to 0 transition.

11.2.1 Part 1

a) Repeat parts a) to d) of subclause 7.3;

b) using the samples that were obtained from part a) above, the LT shall calculate the peak frequency deviation within each bit period in the loopback field of the transmit burst of the IUT, relative to the measured carrier frequency that was calculated in Clause 7;

c) parts a) to b) shall be repeated until the following number of measurements have been made:

Equipment type	Number of measurements
A-field only transmit	100
Half-slot transmit	40
Full-slot transmit	10
Double-slot transmit	5

11.2.2 Part 2

a) Parts a) to d) of subclause 7.3 shall then be repeated using the appropriate sequence listed below:

Equipment type	Test pattern
A-field only transmit:	figure 31
Half-slot transmit:	figure 32
Full-slot transmit:	figure 33
Double-slot:	figure 34

b) using the samples that were obtained from part a) above, the LT shall calculate the peak frequency deviation within each bit period in the loopback field of the transmit burst of the IUT, relative to the measured carrier frequency that was calculated in Clause 7;

c) parts a) to b) shall be repeated until the following number of measurements have been made:

Equipment type	Number of measurements
A-field only transmit	100
Half-slot transmit	40
Full-slot transmit	10
Double-slot transmit	5

11.3 Method of measurement, parts 3 and 4

The measurement period for the deviation measurement shall begin one bit time after the first 0 to 1 or 1 to 0 transition in the test data pattern. The measurement period shall end one bit time before the last 0 to 1 or 1 to 0 transition.

11.3.1 Part 3

a) Parts a) to d) of subclause 7.3 shall be repeated with the sequence "....0101010101010101....";

b) using the samples that were obtained from part a) above, the LT shall calculate the peak frequency deviation within each bit period in the loopback field of the transmit burst of the IUT, relative to the measured carrier frequency that was calculated in Clause 7;

c) parts a) to b) shall be repeated until the following number of measurements have been made:

Equipment type	Number of measurements
A-field only transmit	100
Half-slot transmit	40
Full-slot transmit	10
Double-slot transmit	5

11.3.2 Part 4

a) Parts a) to d) of subclause 7.3 shall be repeated with the sequence "....0101010101010101....";

b) using the samples that were obtained from part a) above, the LT shall calculate the average frequency of the first 16 bits of the synchronisation word and the average frequency of the last 16 bits of the loopback field;

c) the frequency difference between the two calculated values shall be converted into kHz per ms change.

11.4 Verdict criteria for part 1

The peak frequency deviation as measured in part 1 shall be greater than ± 259 kHz and less than ± 403 kHz.

11.5 Verdict criteria for part 2

The peak frequency deviation as measured in part 2 shall be greater than ± 202 kHz and less than ± 403 kHz.

11.6 Verdict criteria for part 3

The peak frequency deviation as measured in part 3 shall be greater than ± 202 kHz and less than ± 403 kHz.

11.7 Verdict criteria for part 4

The rate of change as calculated in part 4 shall not be greater than 13 kHz/ms.

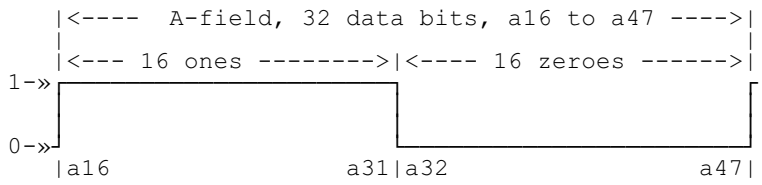
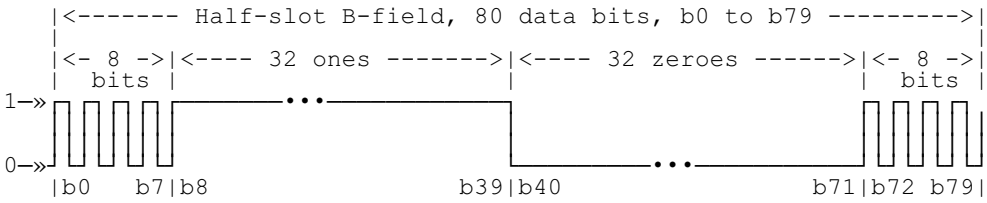
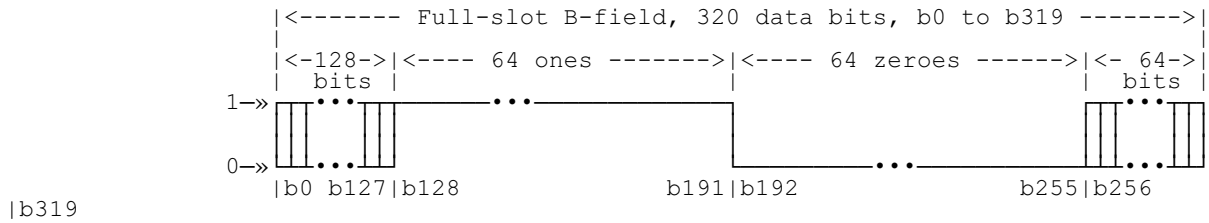


Figure 31: Test packet structure for case 2, A-field



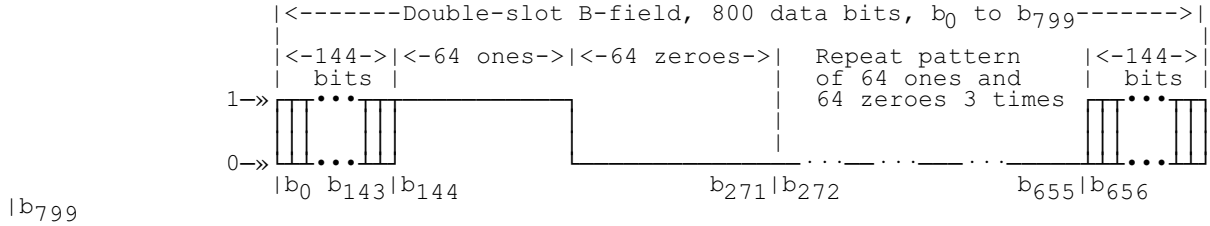
NOTE: Bits b_0 to b_7 and b_{72} to b_{79} are alternating 1s and 0s with the even order bits (b_0, b_2, b_4,...) set to '1' and the odd-order bits (b_1, b_3, b_5,..) set to '0'.

Figure 32: Test packet structure for case 2, Half-slot



NOTE: Bits b_0 to b_{127} and b_{256} to b_{319} are alternating 1s and 0s.

Figure 33: Test packet transmission for case 2, Full-slot



NOTE: Bits b_0 to b_{143} and b_{656} to b_{799} are alternating 1s and 0s.

Figure 34: Test packet transmission for case 2, Double-slot

NOTE: The above fields, (A-field for figure 31, half-slot for figure 32, full-slot for figure 33, and double slot for figure 34) are defined in ETS 300 175-3 [3]. The X-field portions of the half-slot, full-slot, and double-slot B-fields depicted in figures 32 , 33, and 34 are not shown.

12 Unwanted RF power radiation

12.1 General test conditions

If the IUT is equipped with antenna diversity, the IUT shall have the diversity operation defeated for these tests. See subclause 5.5.1 for the appropriate test message reference.

12.2 Emissions due to modulation

See subclause 5.5.1 of ETS 300 175-2 [2].

12.2.1 Definition

The unwanted emission(s) due to modulation is the power measured in any DECT RF channel other than the one in which the IUT is transmitting, integrated over a bandwidth of 1 MHz.

12.2.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture shall be used.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

12.2.3 Method of measurement

a) If the IUT has an external antenna connector then this shall be used to connect the IUT to the LT. Otherwise, the transmitted signal is applied to the LT via a coupling device which provides the appropriate signal level to the system. The analysing system in the LT is operated under the following conditions:

frequency sweep:	1 MHz
resolution bandwidth:	100 kHz
video bandwidth:	greater than resolution bandwidth
integration:	across the frequency sweep
peak hold:	on
sweep time:	greater than 12 seconds
filtering type:	synchronously tuned

The centre frequencies of the DECT RF channels are defined in subclause 7.1.

The total sample time used for measurement is 60 to 80 percent of the duration of the physical packet, starting before 25 % of the slot time has expired but after the transmission of the synchronisation word. The LT must determine the start of the physical packet (bit b0) transmitted by the IUT.

b) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

c) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 16;

d) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

e) using the analysing system, a measurement of the IUT's average transmitted power on channel M is made during the sampling time. This power measurement shall be called Pref;

NOTE: This measurement shall become the reference power for the power measurements of the other channels.

f) using the same procedure, a measurement on all the other DECT channels is made and is recorded in dB as a value relative to P_{ref}. These shall be called P_{rm-2}, P_{rm-1}, P_{rm+1}, P_{rm+2}, etc corresponding to the measurements made on channels Y = M-2 , Y = M-1, Y = M+1 and Y = M+2;

g) using the measured value of transmitted power, NTP, from Clause 10 for channel Y = M, the LT shall calculate the power emissions on each channel. See the following example:

Emissions on channel Y = M + 1: = NTP (dBm) + P_{rm+1} (dB);

h) the value calculated in g) shall be converted from dBm to Watts;

i) steps b) through h) shall be performed with the IUT's transmitter placed on DECT RF channels c = 0, 5, and 9.

12.2.4 Verdict criteria

The unwanted emissions, as measured, shall not be greater than the power levels stated in table 6 below.

Table 6

Emissions on RF Channel "Y"	Maximum Power Level
Y = M ± 1	160 µW
Y = M ± 2	1 µW
Y = any other DECT channel	20 nW*

*NOTE: For "Y = any other DECT channel", the maximum power level shall be less than 20 nW except for one instance of a 500 nW signal.

"M" is the IUT transmit channel and "Y" is a legal DECT channel other than the IUT transmit channel.

12.3 Emissions due to transmitter transients

See subclause 5.5.2 of ETS 300 175-2 [2].

12.3.1 Definition

The power level of all modulation products (including Amplitude Modulation (AM) components due to the switching on or off of the modulated RF carrier) in a DECT RF channel as a result of a transmission on another DECT RF channel.

12.3.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture may be used.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

12.3.3 Method of measurement

a) If the IUT has an external antenna connector then this shall be used to connect the IUT to the LT. Otherwise, the transmitted signal is applied to the LT via a coupling device which provides the appropriate signal level to the system. The analyzing system in the LT is operated under the following conditions:

frequency sweep:	1 MHz
resolution bandwidth:	100 kHz
video bandwidth:	greater than resolution bandwidth
averaging:	none
peak hold:	on
filtering type:	4 or 5 pole synchronously tuned

The centre frequencies of the DECT RF channels are defined in subclause 7.1

The LT must determine the start of the physical packet (bit b0) transmitted by the IUT;

b) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

c) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

d) a test modulation signal D-M2 (see subclause 5.9.4.3) generated by the LT;

e) the analysing system centre frequency is positioned to one end of the 1 MHz band centered on the DECT RF channel being measured;

f) the analysing system shall initiate a power measurement procedure conforming to the limits specified in subclause 5.9.5;

g) using the measured values obtained from parts e) to f), the LT shall select the highest recorded value. This value is compared with the verdict criteria;

h) parts e) to g) are repeated for all DECT RF channels other than the one on which the IUT is transmitting;

i) parts b) to h) shall then be repeated until measurements have been made with the IUT's transmitter placed on all 10 DECT RF channels.

12.3.4 Verdict criteria

The unwanted emissions, as measured, shall not be greater than the power levels stated in table 7.

Table 7

Emissions on RF channel "Y"	maximum peak power level
Y = M ± 1	250 µW
Y = M ± 2	40 µW
Y = M ± 3	4 µW
Y = any other DECT channel	1 µW

"M" is the IUT transmit channel and "Y" is a legal DECT channel other than the IUT transmit channel.

12.4 Emissions due to intermodulation

See subclause 5.5.3 of ETS 300 175-2 [2].

12.4.1 Definition

The power level of intermodulation products that are on any DECT physical channel when any combination of the transmitters at a radio endpoint are in calls on the same slot on different frequencies.

12.4.2 Test environment

If the IUT is a PP equipped with an integral antenna, the IUT and the test antenna shall be mounted in the reference test arrangement as specified in subclause 5.12.1.2.

If the IUT is a RFP with an integral antenna, the IUT and the test antenna shall be mounted in the reference testing arrangement as specified in subclause 5.12.1.2.

If the IUT has an external antenna connector then this test shall preferably take place at a test site, otherwise a test fixture may be used.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

12.4.3 Method of measurement

a) If the IUT has an external antenna connector then this shall be used to connect the IUT to the LT. Otherwise, the transmitted signal is applied to the LT via a coupling device which provides the appropriate signal level to the system. The analysing system in the LT is operated under the following conditions:

frequency sweep:	1 MHz
resolution bandwidth:	100 kHz
video bandwidth:	greater than resolution bandwidth
integration:	across the frequency sweep
peak hold:	on
sweep time:	greater than 12 seconds
filtering type:	synchronously tuned

The centre frequencies of the DECT RF channels are defined in subclause 7.1.

The total sample time used for measurement is 60 to 80 percent of the duration of the physical packet, starting before 25 % of the slot time has expired but after the transmission of the synchronisation word. The LT must determine the start of the physical packet (bit b0) transmitted by the IUT;

b) by means of "force transmit" test messages transmitted by the LT, the IUT shall be placed in a mode whereby two of the transceivers shall be made to operate on the same slot in the frame but on different DECT RF channels. The RF channels shall be c = 0 and c = 9. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

c) the IUT shall be placed in a test mode whereby it performs the loopback function for both transceivers as referenced in subclause 5.10.3;

d) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

e) using the analysing system, a measurement of the transmitted powers on channels M = 0 and M = 9 is made during the sample time for a transmitter in the IUT. These measurements shall be called P_{ref0} and P_{ref9};

f) by means of "force transmit" test messages transmitted by the LT, the IUT shall be placed in a mode whereby two of the transmitters shall be made to operate on the same slot in the frame but on different DECT RF channels. The RF channels shall be M = 3 and M = 6. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

g) using the analysing system, a measurement of the power levels on channels c = 0 and c = 9 is made during the sample time for a transmitter in the IUT. These power measurements shall be called P_{m0} and P_{m9};

h) using the NTPs for c = 0 and c = 9 (as defined in Clause 10, the LT shall calculate the power emissions on channels c = 0 and c = 9. The calculation is performed as per the following:

Emissions on channel 0 = : $= NTP_0$ (dBm) - P_{ref0} (dBm) + P_{m0} (dBm)

Emissions on channel 9 = : $= NTP_9$ (dBm) - P_{ref9} (dBm) + P_{m9} (dBm)

i) parts b) to h) shall be repeated until measurements have been made with all combinations of the IUT's transmitters.

12.4.4 Verdict criteria

The unwanted emissions due to intermodulation shall not be greater than 1 µW as measured in the measurement channels.

12.5 Spurious emissions when allocated a transmit channel

See subclause 5.5.4 of ETS 300 175-2 [2].

12.5.1 Definition

The peak power level of any RF emissions outside the radio frequency band allocated to DECT when a radio endpoint has been allocated a transmit channnel. If a radio endpoint has more than one transceiver, any out of band transmitter intermodulation products shall also be included.

12.5.2 Radiated emissions

12.5.2.1 Test environment

The test shall take place at a test site.

For IUTs with external antenna connectors, test loads shall be attached to each connector.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

12.5.2.2 Method of measurement

a) The analysing system in the LT is operated under the following conditions:

frequency sweep:	as required for frequency range
resolution bandwidth:	refer to table below
display bandwidth:	greater than resolution bandwidth
averaging:	refer to table below
peak hold:	refer to table below
filtering type:	synchronously tuned

Table 8

Frequency offset from edge of band	Resolution Bandwidth	Peak Hold	Averaging
0 ... 2 MHz	30 kHz	on	none
2 ... 5 MHz	30 kHz	on	none
5 ... 10 MHz	100 kHz	on	none
10 ... 20 MHz	300 kHz	on	none
20 ... 30 MHz	1 MHz	on	none
30 ... 12750 MHz	3 MHz	on	none

NOTE: The highest frequency of measurement should not exceed 12,75 GHz.

Measurements shall not be made for transmissions on the RF channel closest to the nearest band edge for frequency offsets of up to 2 MHz.

The centre frequencies of the DECT RF channels are defined in subclause 7.1;

b) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

c) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

d) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

e) the LT shall initiate a power measurement procedure conforming to the limits specified in subclause 5.9.5 using the methods described in Annex B (radiated spurious emissions);

f) the test is made across the RF range from 30 MHz to 12,75 GHz and the power measurements are performed using the resolution bandwidth as indicated in table 8.

NOTE: The sweep time shall be chosen to be slow enough so as to capture at least one burst spurious signal for every measurement point.

12.5.2.3 Verdict criteria

The spurious emissions, as measured, shall not be greater than 250 nW at frequencies below 1 GHz and 1 µW at frequencies above 1 GHz throughout this test.

In addition, not regarding up to 2 instances of a continuous-wave spurious signal for PPs for which the total peak power level shall be less than 250 nW as measured in a 3 MHz measurement bandwidth, the peak power level shall be less than 20 nW in a 100 kHz measuring bandwidth for the following broadcast bands:

47 -	74 MHz
87,5 -	108 MHz
108 -	118 MHz
174 -	230 MHz
470 -	862 MHz

12.5.3 Conducted spurious emissions

12.5.3.1 Test environment

The test shall take place at a test site.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

12.5.3.2 Method of measurement

a) The IUT shall be connected to the LT via the external antenna connector;

b) carry out the test parts b) to f) in subclause 12.5.2.2 except in test part e), using the methods described in Annex C (conducted spurious emissions).

12.5.3.3 Verdict criteria

The spurious emissions, as measured, shall not be greater than 250 nW at frequencies below 1 GHz and 1 µW at frequencies above 1 GHz throughout this test.

In addition, not regarding up to 2 instances of a continuous-wave spurious signal for PPs for which the total peak power level shall be less than 250 nW as measured in a 3 MHz measurement bandwidth, the peak power level shall be less than 20 nW in a 100 kHz measuring bandwidth for the following broadcast bands:

47 -	74 MHz
87,5 -	108 MHz
108 -	118 MHz
174 -	230 MHz
470 -	862 MHz

13 Radio receiver testing

13.1 Radio receiver sensitivity

See subclause 6.2 of ETS 300 175-2 [2].

13.1.1 Definition

The radio receiver sensitivity is defined as the power level at the receiver input at which the bit error rate is 0,001.

13.1.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture or temporary connector shall be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.1.3 Method of measurement

a) The IUT shall be oriented in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the LT is programmed to set its RF transmission to a power level such that - 83 dBm is present at the input of the IUT receiver. If the IUT is declared as being a FT with the PAP, the signal strength shall be set to - 86 dBm;

c) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

   NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

d) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

e) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

f) the LT calculates the BER of the IUT;

g) the LTU shall offset the frequency of the test signal by 50 kHz and repeat parts b) to g). This sequence of steps shall be repeated twice to include both positive and negative frequency offsets;

h) parts b) to g) shall be repeated for all 10 DECT RF channels.

13.1.4 Verdict criteria

The BER of the IUT shall be less than or equal to 0,001 for the duration of this test.

13.2 Radio receiver reference bit error rate

See subclause 6.3 of ETS 300 175-2 [2].

13.2.1 Definition

The radio receiver reference bit error rate is the maximum allowed bit error rate for a power level at the receiver input of - 73 dBm or greater (i.e. 70 dBµV/m).

13.2.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture shall be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.2.3 Method of measurement

a) The IUT shall be oriented in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the LT is programmed to set it's RF transmission to a power level of - 73 dBm at the input of the IUT receiver;

c) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency with handover disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

d) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

e) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

f) the LT calculates and records the BER of the IUT;

g) parts b) to f) shall be repeated for all 10 DECT RF channels.

13.2.4 Verdict criteria

The BER as measured of the IUT shall be 0,00001 or less.

13.3 Radio receiver interference performance

See subclause 6.4 of ETS 300 175-2 [2].

13.3.1 Definition

The ability of DECT equipment to continue receiving in the presence of an interfering signal on the same or different DECT RF channel.

13.3.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture may be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.3.3 Method of measurement

a) The IUT shall be oriented in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the LT is programmed to set its RF transmission to a power level of - 73 dBm at the input of the IUT receiver;

c) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer setup procedure.

d) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

e) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

f) the LT transmits in addition to the D-M2 data test pattern, a modulated DECT-like carrier (see subclause 5.9.4.1) on channel "Y" whose level is determined by the table below:

Table 9

interferer on RF channel "Y":	interferer signal strength (dBμV/m)	(dBm)
Y = M	60	- 83
Y = M ± 1	85	- 58
Y = M ± 2	104	- 39
Y = any other DECT channel	110	- 33

NOTE: The RF carriers "Y" shall include the three nominal DECT RF carrier positions immediately outside each edge of the DECT band.

g) the LT calculates and records the BER;

h) parts b) to g) shall be repeated so that the single interfering DECT-like carrier has been placed on all the remaining DECT channels. Table 9 in part f) indicates the amplitude of the interferer;

i) parts b) to h) shall be repeated for all 10 DECT RF channels.

13.3.4 Verdict criteria

The BER as measured of the IUT shall be 0,001 or less.

13.4 Radio receiver blocking case 1: other asynchronous DECT channels

See subclause 6.5.1 of ETS 300 175-2 [2].

13.4.1 Definition

The receiver should work in the presence of strong signals on other frequencies. These interferers may be modulated carriers or single continuous-wave carriers.

13.4.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture shall be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.4.3 Method of measurement

a) The IUT shall be oriented in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the power level of the RF transmission from the LT shall be set to 3 dB above the sensitivity limit;

c) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. The frequency chosen shall be RF channel 4 of the DECT RF channels. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference.

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

d) the IUT shall be placed in a test mode whereby it performs the loopback function as referenced in subclause 5.10.3;

e) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

f) the LT transmits in addition to the D-M2 signal a single continuous-wave interferer at a frequency and level determined by table 10 below:

Table 10

Frequency (f)	Continuous sine wave carrier level (dBμV/m)
25 MHz ≤ f < 1 780 MHz	120
1 780 MHz ≤ f < 1 875 MHz	100
| f- fc | > 6 MHz	100
1 905 MHz < f ≤ 2 000 MHz	100
2 000 MHz < f ≤ 12,75 GHz	120

g) the testing system calculates and records the BER of the IUT;

h) parts f) to g) are repeated until the LT has tested all interfering carrier ranges shown in table 10 in part f).

13.4.4 Verdict criteria

The BER as measured of the IUT shall be 0,001 or less for the duration of this test.

13.5 Radio receiver blocking case 2: in-channel interference

See subclause 6.5.2 of ETS 300 175-2 [2].

13.5.1 Definition

When a high level interferer is present in a physical channel other than the one the receiver is on, the receiver is able to continue receiving the desired signal.

13.5.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture shall be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.5.3 Method of measurement

a) The IUT shall be orientated in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the LT is programmed to set its RF transmission to a power level of -73 dBm at the input of the IUT receiver;

c) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUTshall be disabled. See subclause 32 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

d) the LT shall record the IUT's RF channel and slot position as "M" and "N+2" respectively;

e) the IUT shall be placed in a test mode whereby it performs the loopback functionas referenced in subclause 5.10.3;

f) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

g) the LT transmits at the same time a DECT-like physical packet interferer in slot "N" at a level of - 14 dBm. See subclause 5.9.4.1 for a description of this interferer;

NOTE: The power of level any emissions by the LT on slot "N+1" shall be less than - 93 dBm.

h) the LT is programmed to set its RF transmission in slot "N+2" to a power level of - 83 dBm at the input of the IUT receiver;

i) the testing system calculates and records the BER of the IUT;

j) the LT increments the value of "N" and repeats parts b) to i) until all slot positions with the exception of N+1 and N+2 have been tested;

k) parts b) to j) shall be repeated with the IUTs receiver placed on all 10 DECT RF channels.

13.5.4 Verdict criteria

The BER as measured of the IUT shall be 0,001 or less for the duration of this test.

13.6 Receiver intermodulation performance

See subclause 6.6 of ETS 300 175-2 [2].

13.6.1 Definition

With a call set up on a particular physical channel, two interferers are introduced so that they can produce an intermodulation product on the physical channel already in use.

13.6.2 Test environment

The test should preferably take place at a test site, otherwise a test fixture shall be used.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.6.3 Method of measurement

a) The IUT shall be oriented in the reference position as determined in subclause 5.1.2.3 if no antenna connector is available;

b) the LT is programmed to set its RF transmission level to a power level of - 80 dBm at the input of the IUT receiver;

c) the IUT's RF channel is recorded as channel "M";

d) the LT shall place the IUT in a mode whereby the IUT is positioned in a LT specified slot and frequency. If so equipped, the handover function in the IUT shall be disabled. See subclause 5.10.3 for the appropriate test message reference;

NOTE: For an IUT that is declared as being PAP compliant, the reception of this command will cause the IUT to initiate it's bearer set-up procedure.

e) the IUT shall be placed in a test mode whereby it performs the loopback functionas referenced in subclause 5.10.3;

f) a test modulation signal D-M2 (see subclause 5.9.4.3) is generated by the LT;

g) the LT then transmits in addition to the D-M2 test signal, a modulated DECT-like carrier "B" and a continuous-wave carrier "A" whose intermodulation product is present within the DECT channel 'M' of the IUT. The level of these carriers is set to - 46 dBm at the receiver input of the IUT. The measurement is performed 4 times with the interfering carriers and the IUT receive channel positioned on the DECT RF channels as per the following table:

Table 11

M	A	B
5	7	9
5	3	1
0	2	4
9	7	5

h) the LT calculates and records the BER of the IUT in the loopback field for each of the channel combinations shown in the table above.

13.6.4 Verdict criteria

The BER as measured shall be less than 0,01 for the duration of this test.

13.7 Spurious emissions when the radio endpoint has no allocated transmit channel

See subclause 6.7 of ETS 300 175-2 [2].

13.7.1 Definition

The power level of any spurious emission when the radio endpoint has not been allocated a transmit channel.

13.7.2 Test environment

The test shall take place at a test site.

Connection between the IUT and the LT shall be made by means of a test antenna.

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

13.7.3 Method of measurement

a) The IUT is connected to a spectrum analysing system input via an antenna coupling device which provides the appropriate signal level to the analyser. The analyser controls are set to the following:

frequency span:	as required for frequency range
resolution bandwidth:	1 MHz (in DECT band)
	100 kHz (outside DECT band)
video bandwidth:	greater than resolution bandwidth
averaging:	none
peak hold:	on
filtering type:	synchronously tuned for measurements in the DECT band

b) the IUT shall be oriented in the reference position as determined in subclause 5.12.3;

c) the IUT is placed into a receive or idle mode for the duration of this test;

d) the test is made across the RF range of 30 MHz to 12,75 GHz and the power measurements are performed using the resolution bandwidths as indicated in part a) above.

13.7.4 Verdict criteria (outside the DECT band)

The IUT shall conform to the following limits:

- the emissions as measured shall not be greater than 2 nW between 30 MHz and 1 GHz; and

- between 1 GHz and 12,75 GHz, the emissions as measured shall not exceed 20 nW.

13.7.5 Verdict criteria (inside the DECT band)

The IUT shall conform to the following limits.

The power level as measured of any spurious emissions shall not exceed 2 nW in a 1 MHz bandwidth.

The following exceptions are allowed:

a) in one 1 MHz band within the DECT frequency band, the maximum allowable ERP shall be 20 nW;

b) in up to two bands of 30 kHz, the maximum ERP shall be less than 250 nW.

14 Synchronisation port (FT only)

See Annex C of ETS 300 175-2 [2].

14.1 Description

The (optional) synchronisation ports allow adjacent DECT FTs to achieve frame synchronisation. Two classes of synchronisation are specified:

Class 1: Guard Band Alignment : no handover between FTs;

Class 2: Guard Band Alignment : handover between FTs.

The requirements of handover result in different timing tolerances between the two classes.

The synchronisation pulse is positive (true) logic. The voltage levels of this pulse corresponds to those defined in CCITT Recommendation V.11 [29].

14.2 Test environment

The test shall take place under nominal supply voltage conditions and at a nominal temperature.

The test should preferably take place at a test site, otherwise a test fixture shall be used.

The LT will provide CCITT Recommendation V.11 [29] compatible testing ports for this test. The connecting cable between the LT and IUT ports shall be shielded.

Connection between the LT and the IUT for the RF sampling shall be by means of a test antenna or test fixture.

14.3 FT as the master

14.3.1 Method of measurement

a) The IUT shall be orientated in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the IUTs' synchronisation output port shall be connected to the LTUs' input port;

c) a bearer shall be set-up between the LT and the IUT. The position of the bearer shall be in slots 0 and 12 of the DECT frame;

d) the LT shall:

   d_1) use the sampling method described in subclause 5.12.1.2 of this document to capture a representation of a physical packet transmitted by the IUT;

   d_2) determine the position of b0 in the physical packet;

   d_3) at the same time, sample the synchronisation pulse coming out of the IUT. The frame number in which the pulse is sampled shall be recorded.

e) part d) shall be repeated for 50 frames;

f) the LT shall calculate the widths of the synchronisation pulses. The calculated widths shall be recorded along with the frame numbers;

g) the LT shall calculate the time delay, Td, between the falling edge of each synchronisation pulse to bit b0 of that pulses' sampled RF packet;

14.3.2 Verdict criteria

The time delay, T_d, pulse widths, and voltages, as measured, shall meet the following limits:

1) the width of the synchronising pulse shall be between 2 ms and 5 ms for frame 0 and between 5 µs and 1 ms for all other frames;

2) T_d = 15 µs ± 5 µs for Class 1 FTs;

3) T_d = 15 µs ± 2 µs for Class 2 FTs;

4) the voltage levels as defined in CCITT Recommendation V.11 [29].

14.4 FT as the slave

14.4.1 Method of measurement

a) The IUT shall be orientated in the reference position as determined in subclause 5.12.3 if no antenna connector is available;

b) the IUT's synchronisation input port shall be connected to the LT's output port;

c) a bearer shall be set-up between the LT and the IUT. The position of the bearer shall be in slots 0 and 12 of the DECT frame;

d) the LT shall:

d_1) generate a synchronisation pulse in conformance with the limits specified for master FTs in Annex C of ETS 300 175-2 [2];

d_2) use the sampling method described in subclause 5.12.1.2 of this document to capture a representation of a physical packet transmitted by the IUT;

d_3) determine the position of b0 in the physical packet.

e) part d) shall be repeated for 50 frames;

f) the LT shall calculate the time delay, Td, between the falling edge of each synchronisation pulse it generated to bit b0 of that pulses' sampled RF packet from the IUT;

g) if the IUT is designated as being Class 2, then the test authority shall verify that the time delay, Td, can be set to 0 µs, 15 µs and 20 µs. The method of adjustment is manufacturer-specific and shall be declared to the test authority.

14.4.2 Verdict criteria: Class 1 FTs

The time delay, T_d, shall be 15 µs ± 5 µs. The voltage levels as measured shall comply with those defined in CCITT Recommendation V.11 [29].

14.4.3 Verdict criteria: Class 2 FTs

The time delay, T_d, shall be 15 µs ± 2 µs and shall be able to be set to 0 µs, 15 µs and 20 µs ± 2 µs. The voltage levels as measured shall comply with those defined in CCITT Recommendation V.11 [29].

15 Speech and telephony tests

15.1 Test configurations

15.1.1 General

A DECT system comprises a PP and a FP. As these parts are not always purchased together, it is a requirement that either the complete system or each of the two separate parts shall be capable of being tested. However, a PP, together with a reference FP (ReFP), or a FP, together with a reference PP (RePP), can be considered to represent the relevant characteristics of the complete system. ReFP and RePP referred to in the following subclauses, are part of the LT described in subclause 5.9.1.

15.1.2 Testing a DECT system

Complete system tests involve the two-way transmission between the acoustic input and output of a PP and a digital S reference point of a FP. The situation is the same as in ETS 300 085 [14], and as far as possible the same testing methods and testing equipment are used. The general test methods described in subclause 15.1.3 are applicable except that the ReFP and the RePP are replaced by a FP or a PP of the DECT system.

15.1.3 Testing a separate PP or FP

The performance of the PP is measured by means of a ReFP. The performance of the FP, is measured by means of a RePP.

The ReFP and RePP shall provide the equivalent of true air interface measurements and therefore shall not contain circuitry which will modify the true air interface speech frequency performance. To meet these requirements, measurements shall be referred to a uniform PCM reference point. The CCITT

Recommendation G.721 [16] algorithm requires such a uniform interface, although in the case of DECT it may not be physically available.

The transcoding algorithms are specified such that encoding and decoding are symmetrical, i.e. with an encoder and decoder connected in tandem, the "levels" of the digital signals at the uniform PCM input to the encoder and output from the decoder are identical. Once the speech channel signals are in the digital domain they are essentially lossless and hence the level at the air interface can be related to any digital interface.

Ideally, to measure the send signals from the PP at the air interface, a PCM level metre would be connected to the reference decoder uniform PCM output, and to generate receive signals for the PP at the air interface, a PCM signal generator would be connected to the reference encoder uniform PCM input.

A more practical means of measuring the speech channel performance may be achieved by converting the uniform PCM to standard μ or A-law PCM and then using a standard PCM test set and applying the appropriate correction factor as defined in CCITT Recommendations G.711 [24] and G.721 [16], (although this could have a negative effect on some parameters such as distortion).

Two possible general test methods are described here. The first is commonly called the direct digital processing approach. In this approach, the digital bit-stream is operated upon directly. See figure 35.

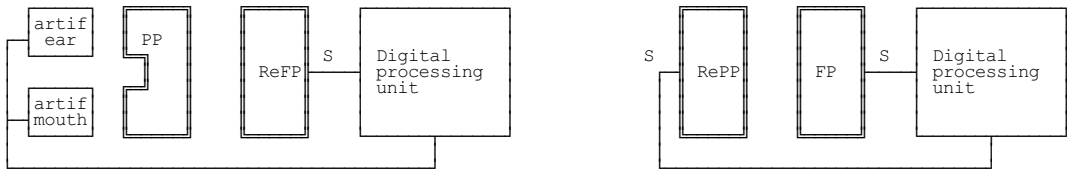


Figure 35: The direct digital processing approach test configurations for a separate PP and a separate FP

The second measurement method involves the use of an ideal codec. In this case, a codec is used to convert the digital bit-stream to the equivalent analogue value, so that existing test procedures and existing analogue measuring equipment can be used. See figure 36.

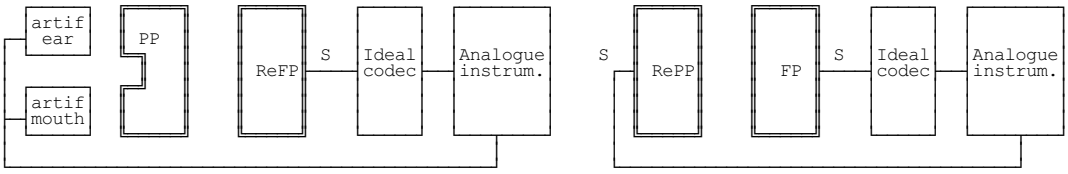


Figure 36: The ideal codec approach, test configuration for a separate PP and a separate FP

15.1.4 Reference FP (ReFP) and Reference PP (RePP)

A ReFP and RePP are shown in figures 35 and 36, and they incorporate the specified transcoder algorithm as described in CCITT Recommendation G.721 [16].

Both the ReFP and the RePP shall have the ability to loopback the ADPCM signal with a 5 ms delay.

NOTE: This 5 ms delay corresponds to the delay between the receive and transmit timeslots of a duplex bearer.

The uniform PCM reference points, points C and D in figure 37, are those designated SL and SR in CCITT Recommendation G.721 [16].

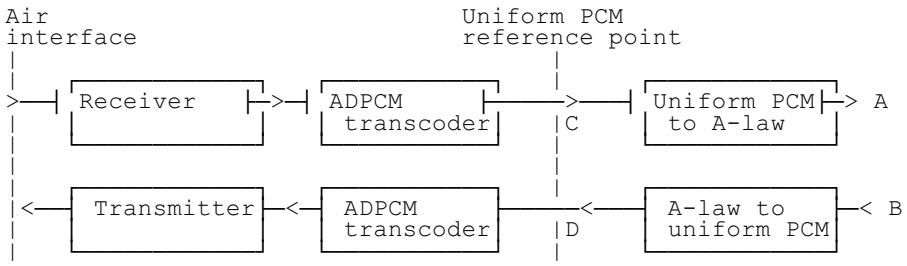


Figure 37: Reference FP and PP

15.1.5 Applicability of tests

This subclause indicates whether each test is applicable to the PP, FP or to the system (PP and FP combined). It is intended for information only.

Table 12

Subclause Number of Test	Applicable to		
	PP	FP	System
15.6	■	■	■
15.7	■		■
15.8	■		■
15.9.1	■		■
15.9.2	■		■
15.10.1	■		■
15.10.2	■		■
15.11	■		■
15.12	■	■	■
15.13	■		■
15.14	■		■
15.15	■		■
15.16	■	■	■
15.17	■	■	■
15.18	■		■
15.19	■		■
15.20	■		■
15.21	■		■
15.22	■		■
15.23	■		■
15.24	■		■
15.25	■		■
15.26	■		■
15.27	■		■
15.28	■		■
15.29.1	■		■
15.29.2	■		■
15.30	■		■
15.31	■		■
15.32		■	
15.33		■	■
15.34	■		
15.35	■		■

15.2 Digital signal level

The "level" of the digital signal at the uniform companded PCM and ADPCM interfaces are defined in dBm0. A 1 kHz sine wave whose peak signal corresponds with the maximum PCM code is assigned a level of + 3,14 dBm0 (CCITT Recommendation G.711 [24]).

The relationship between the PCM encoding law and the audio signal level is defined in CCITT Recommendation G.711 [24]. The theoretical load capacity of CCITT Recommendation G.721 ADPCM is the same as for A-law PCM. For sensitivity and loudness rating calculations the notional voltage assigned to a digital signal is calculated assuming an associated impedance of 600 õ. Thus 0 dBm0 is equivalent to a voltage of + 2,2 dBV.

The Acoustic Reference Level (ARL) is the acoustic level that corresponds to a power level of - 10 dBm0 at the digital interface.

15.3 General conditions of test

Unless otherwise stated, the tests are made under the normal operating conditions specified in subclauses 6.2.

The PP or FP under test shall be tested in conjunction with the ReFP or the RePP respectively, separated by some unobstructed distance, between 2 m and 10 m, in a room with an ambient sound noise level of less than 30 dBA. In addition, the room shall be a relatively noiseless RF environment such that the normal handshaking between FP and PP is maintained. A connection shall be established and maintained for a two-way speech transmission.

Unless otherwise stated in a particular test, where the PP under test has fixed geometry, the PP is placed in the LRGP as described in CCITT Recommendation P.76 [25], Annex A . Where the PP has variable geometry, the front plane of the mouthpiece is mounted 15 mm in front of the lip ring and coaxial with the artificial mouth. Fixed and variable geometry are defined in ETS 300 175-8 [8], subclause 3.1. A PP with movable parts, having a natural position during on-line conditions shall be regarded as being a fixed geometry PP.

All tests regarding echoes are defined for steady states. Care shall be taken by the manufacturer to ensure that transition states do not cause quality degradation.

15.4 Ideal codec

The ideal codec approach uses a codec to convert the companded digital bit stream to the equivalent analogue values, so that existing test equipment and procedures may be used. This codec should be a high quality codec whose characteristics are close to ideal. The codec should have characteristics such as attenuation/frequency distortion, idle channel noise, quantising distortion etc. which exceed the reference codec requirements specified in CCITT Recommendation G.714 [20] so as not to mask the corresponding parameters of the apparatus under test. The linear A/D and D/A convertors used by the codec should have at least 14 bit resolution, and the filter response should lie within the upper and lower limits given in table 13.

Table 13: Frequency/sensitivity response of reference codec

	Frequency Hz	Loss dB
Upper limit	0	0,00
	80	0,00
	80	- 0,25
	3 600	- 0,25
	3 600	0,00
	4 000	0,00
Lower limit	100	+ 40,00
	100	+ 0,25
	3 000	+ 0,25
	3 000	+ 0,90
	3 400	+ 0,90
	3 400	+ 40,00

The limit curves shall be determined by straight lines joining successive co-ordinates given in table 13, when the loss is plotted on a linear axis against frequency on a logarithmic axis.

15.5 Electro-acoustical equipment

The artificial mouth and the artificial ear shall conform to CCITT Recommendation P.51 [21].

The sound level metre shall conform to IEC 651 [32], type 1.

15.6 Speech coding scheme

See subclause 5.1 of ETS 300 175-8 [8].

Compliance shall be by manufacturer's declaration.

For these highly integrated products, it is not intended to require a PCM interface (uniform or logarithmic) for testing purposes only, therefore, compliance shall be made by a manufacturer's declaration.

15.7 PP sending frequency response

See subclause 7.1.1 of ETS 300 175-8 [8].

A pure tone signal of - 4,7 dBPa is applied at the Mouth Reference Point (MRP) as described in CCITT Recommendation P.64 [22], using an artificial mouth conforming to CCITT Recommendation P.51 [21].

A digital measuring instrument, or an ideal codec followed by an analogue level measuring set, is connected to point A of the ReFP as shown in figure 37, or to the S-reference point of a FP.

Measurements are made at one twelfth-octave intervals as given by the R40 series of preferred numbers in ISO Publication 3 [28] for frequencies from 100 Hz to 4 kHz inclusive. At each frequency the level for an input sound pressure of - 4,7 dBPa is measured.

15.8 PP receiving frequency response

See subclause 7.1.2 of ETS 300 175-8 [8].

A digital signal generator, or an analogue signal generator followed by an ideal codec, is connected to point B of the ReFP as shown in figure 37, and the level adjusted to produce a level of - 16 dBm0 at the uniform PCM reference point.

Measurements are made at one twelfth-octave intervals as given by the R40 series of preferred numbers in ISO Publication 3 [28] for frequencies from 100 Hz to 4 kHz inclusive. At each frequency, the sound pressure level in the artificial ear is measured.

15.9 PP loudness rating

See subclause 7.2.1 of ETS 300 175-8 [8].

15.9.1 SLR_H

A digital measuring instrument, or an ideal codec followed by an analogue level measuring set, is connected to point A of the ReFP as shown in figure 37, or to the S-reference point of a FP.

The sending sensitivity is measured at each of the 14 frequencies given in table 2 of CCITT Recommendation P.79 [23], bands 4 - 17. The method of measurement of sending sensitivity (sending frequency response) is described in subclause 15.7.

The sensitivity is expressed in terms of dBV/Pa and the loudness rating is calculated according to the formula 4.19b of CCITT Recommendation P.79 [23] over bands 4 - 17, and using the sending weighting factors from table 2, adjusted according to table 3 of the CCITT Recommendation P.79 [23].

15.9.2 RLR_H

A digital measuring instrument, or an ideal codec followed by an analogue level measuring set, is connected to point A of the ReFP as shown in figure 37, or to the S-reference point of a FP.

The receiving sensitivity is measured at each of the 14 frequencies given in table 2 of CCITT Recommendation P.79 [23], bands 4 - 17.

The sensitivity is expressed in terms of dBPa/V and the loudness rating is calculated according to the formula 4.19c of CCITT Recommendation P.79 [23] over bands 4 - 17, and using the sending weighting factors from table 2 of CCITT Recommendation P.79 [23], adjusted according to table 3. The artificial ear

sensitivity shall be corrected using the real ear correction of table 4 of the CCITT Recommendation P.79 [23].

NOTE: CCITT Recommendation P.65 [26] allows the use of alternative signal sources for measurements of loudness ratings. If such a signal source is used, it is the responsibility of the test authority to ensure that the method used is equivalent to that described above.

The requirement shall be met with RLR_H corrected to the nominal value of RLR_H as defined in subclause 7.2.1 of ETS 300 175-8 [8].

15.10 User controlled volume control in PP

See subclause 7.2.2 of ETS 300 175-8 [8].

The limits of the variation of RLR and SLR are given in the following table.

Table 14: Absolute limits for "joint-acting" volume control

Volume setting	Maximum	Minimal
RLR	- 8 dB	18 dB
SLR	18 dB	4 dB

Table 15: Absolute limits for a receiving volume control

Volume setting	Maximum	Minimum
RLRH	- 8 dB	18 dB

15.10.1 SLR_H

Test conditions as in subclause 15.9.1.

15.10.2 RLR_H

Test conditions as in subclause 15.9.2.

15.11 PP adaptive volume control

See subclause 7.2.3 of ETS 300 175-8 [8].

Compliance shall be by manufacturer's declaration, until a test method has been specified.

15.12 FP adaptive volume control

See subclause 7.2.4 of ETS 300 175-8 [8].

Compliance shall be by manufacturer's declaration, until a test method has been specified.

15.13 PP talker sidetone masking rating

See subclause 7.3.1 of ETS 300 175-8 [8].

The nominal value of the Sidetone Masking Rating (STMR) shall be 13 ± 5 dB.

Where a user-controlled receiving volume control is provided it shall be set at the nominal setting.

A pure tone signal of - 4,7 dBPa is applied at the MRP as described in CCITT Recommendation P.64 [22], using an artificial mouth conforming to CCITT Recommendation P.51 [21].

Measurements are made at one third-octave intervals as given by the R40 series of preferred numbers in ISO 3 [28] for frequencies from 100 Hz to 4 kHz inclusive. At each frequency the level at the artificial ear is measured.

The Sidetone path Loss (Lmest) is expressed in dB and the STMR is calculated from the formula 8-4 of CCITT Recommendation P.79 [23], using the weighting factors of column 3 in table 6 (unsealed), and values of real ear correction in accordance with table 4.

The requirement shall be met with SLR_H and RLR_H corrected to the nominal values of SLR_H and RLR_H.

15.14 Listener sidetone

See subclause 7.3.2 of ETS 300 175-8 [8].

The value of the Listener Sidetone Rating (LSTR) shall not be less than 10 dB.

For PPs with declared noise rejection capability the value of the LSTR shall not be less than 15 dB.

Where a user-controlled receiving volume control is provided it shall be set at the nominal setting.

The sound field is calibrated in the absence of any local obstacles. The averaged field should be uniform to within + 4 dB/- 2 dB within a radius of 0,15 m of the MRP, when measured in one-third octave bands from 100 Hz to 8 kHz (bands 1 to 20).

A calibrated half-inch microphone is mounted at MRP. The sound field is measured in one-third octave bands. The power density spectrum should correspond to that published by "Hoth" (see CCITT Series P Recommendations Part II: Supplement 13.[27]) to within ± 1 dB and the level should be adjusted to 50 dBA (- 44 dBPa (A)). The tolerance on this level is ± 1 dB.

NOTE: Where adaptive techniques or voice switching circuits are not used, it is recommended to increase the sound level to 60 dBA (- 34 dBPa (A)) to increase measurement accuracy.

The artificial mouth and ear are placed in the correct position relative to MRP, and the PP is mounted at LRGP and the earpiece is sealed to the knife-edge of the artificial ear.

Measurements are made in one-third octave bands for the 14 bands centred at 200 Hz to 4 000 Hz (bands 4 to 17). For each band the sound pressure in the artificial ear is measured by connecting a suitable measuring set to the artificial ear.

The listener sidetone path loss is expressed in dB and the LSTR is calculated from the formula 8-4 of CCITT Recommendation P.79 [23], using the weighting factors in column (3) in table 6, and the values of LE in accordance with table 4 of CCITT Recommendation P.79 [23].

The requirement shall be met with SLR_H and RLR_H corrected to the nominal values of SLR_H and RLR_H.

15.15 Terminal Coupling Loss of a PP

See subclause 7.4.1.1 of ETS 300 175-8 [8].

a) A digital signal generator, or an analogue signal generator followed by an ideal codec, is connected to point B of the ReFP as shown in figure 37;

b) the signal generator is set to provide a signal level of 0 dBm0 at the uniform PCM point D of figure 37;

c) the PP is suspended in free air in a Low Noise Room (LNR) in such a way that the inherent mechanical coupling of the handset is not affected. The testing shall be made under free field conditions (the deviations from ideal free field conditions shall be less than ± 1 dB). The ambient noise level shall be less than 30 dBA;

d) the level at the uniform PCM reference point, point C of figure 37, is evaluated using the level metre for one twelfth-octave intervals as given by the R40 series of preferred numbers in ISO Publication 3 [28] for frequencies 300 Hz to 3 400 Hz;

e) the weighted Terminal Coupling Loss (TCLw), is calculated according to CCITT Recommendation G.122 [17].

15.16 Artificial echo loss of a FP with a 4-wire interface

See subclause 7.4.1.2.a) of ETS 300 175-8 [8].

The FP shall have its artificial echo path activated and the speech path via the air interface de-activated. Any echo control device as specified in subclause 7.4.1.2b) of ETS 300175-8 [8] shall be disabled.

A digital signal generator, or analogue signal generator followed by an ideal codec is connected to the S-interface of the FP, corresponding to point B of the ReFP as shown in figure 37.

The signal generator is set to provide a signal level of 0 dBm0 at the input of the S-interface.

The level at the output of the S-interface is evaluated using the level metre for one twelfth-octave intervals as given by the R40 series of preferred numbers in ISO 3 [28] for frequencies 300 Hz to 3 400 Hz.

The artificial echo loss is calculated according to CCITT Recommendation G.122 [17].

15.17 Echo control device of a FP with a 4-wire interface

See subclauses 7.4.1.2 b) and 8.2.1.2.1 and 8.3.2 of ETS 300 175-8 [8].

The FP shall have its echo control device activated and no activated artificial echo path.

A digitial signal generator, or analogue signal generator followed by an ideal codec is connected to the S-interface of the FP, corresponding to point B of the ReFP as shown in figure 37.

The signal generator is set to provide a signal level of 0 dBm0 at the input of the S-interface.

The input of the S-interface at the RePP is connected to the output of the S-interface at the RePP with a 34 dB loss.

The level at the output of the S-interface at the FP is evaluated using the level metre for one twelfth-octave intervals as given by the R40 series of preferred numbers in ISO Publication 3 [28] for frequencies 300 Hz to 3 400 Hz.

The TCLw is calculated according to CCITT Recommendation G.122 [17].

15.18 Stability loss - fixed geometry

See subclause 7.4.2.2.1 of ETS 300 175-8 [8].

a) The PP shall be placed on one inside surface of three perpendicular plane smooth hard surfaces forming a corner. Each corner shall extend 0,5 m from the apex of the corner. One surface shall be marked with a diagonal line extending from the corner and a reference position marked on the line 250 mm from the corner.

   The PP shall be positioned centrally along the diagonal line with the earcap nearer to the apex of the corner such that:

   a_1) the mouthpiece and earcap shall face towards the surface; and

   a_2) the extremity of the PP shall coincide with the normal to the reference point.

b) with the digital signal generator, or the analogue signal generator followed by an ideal codec, set to provide a signal level of 0 dBm0 at the uniform PCM point D of figure 37, the attenuation from the input B to the output A is measured at one-twelfth octave intervals for frequencies in the range 200 Hz to 4 000 Hz under the following conditions.

15.19 Stability loss variable geometry

See subclause 7.4.2.2.2 of ETS 300 175-8 [8].

The equipment shall be capable of meeting the requirement in at least one of the two following conditions:

1) if it is possible to position the earpiece in front of the mouthpiece with a distance of 150 mm between the front planes of each, the requirement shall be met in this relative position and in the just off-hook position;

2) if the relative movement and orientation of the acoustic and electromagnetic elements are limited by means of a hinge or similar mechanism, the requirement shall be met in any relative position and orientation that can be achieved whilst the PP is in active condition, i.e. a communication is established over the air interface.

With the digital signal generator, or the analogue signal generator followed by an ideal codec, set to provide a signal level of 0 dBm0 at the uniform PCM point D of figure 37, the attenuation from the input B to the output A is measured at one-twelfth octave intervals for frequencies in the range 200 Hz to 4 000 Hz.

15.20 Sending distortion

See subclause 7.5.1 of ETS 300 175-8 [8].

Neither of the test methods defined in ETS 300 085 [14] is appropriate when ADPCM coding is used. Therefore a provisional test method is used. A more general test method is under study. It will replace the present one when available.

A pure tone signal of - 4,7 dBPa and nominal frequency between 1 004 Hz and 1 025 Hz is applied at the MRP as described in CCITT Recommendation P.64 [22], using an artificial mouth conforming to CCITT Recommendation P.51 [21].

A digital measuring instrument, or an ideal codec followed by an analogue level measuring set, is connected to point A of the ReFP as shown in figure 37 or to the S-reference point of a FP.

The ratio of the signal to total distortion power at the output A is measured with the psophometric noise weighting as described in CCITT Recommendations G.714 [20] and CCITT Recommendation G.132 [18].

15.21 Receiving distortion

See subclause 7.5.2 of ETS 300 175-8 [8].

Neither of the test methods defined in ETS 300 085 [14] are appropriate when ADPCM coding is used. Therefore, the following requirements are copied from prI-ETS 300 131 on the Common Air Interface (CAI). A more general test method is under study. It will replace the present one when available.

A digital signal generator, or an analogue signal generator followed by an ideal codec, is connected to point B of the ReFP as shown in figure 37 or to the S-reference point of a FP, and the level adjusted to produce a digitally simulated sine-wave of nominal frequency between 1 004 Hz and 1 025 Hz at a level of - 10 dBm0 at the uniform PCM reference point D.

The ratio of signal to total distortion power of the signal output in the artificial ear is measured with the psophometric noise weighting. See figures 35 and 36 and CCITT Recommendation G.714 [20] and CCITT Recommencation G.132 [18].

15.22 Side tone distortion

See subclause 7.5.3 of ETS 300 175-8 [8].

The PP is mounted at LRGP and the earpiece is sealed to the knife-edge of the artificial ear. An instrument capable of measuring the third harmonic distortion of signals with fundamental frequencies in the range of 315 Hz to 1 000 Hz is connected to the artificial ear.

A pure-tone signal of - 4,7 dBPa is applied at the mouth reference point at frequencies of 315 Hz, 500 Hz and 1 000 Hz. For each frequency, the third harmonic distortion is measured in the artificial ear.

15.23 Out of band (sending)

See subclause 7.6.1 of ETS 300 175-8 [8].

a) A digital measuring instrument, or an ideal codec followed by an analogue level measuring set, is connected to point A of the ReFP as shown in figure 37 or to the S-reference point of a FP;

b) a pure sine wave of level - 4,7 dBPa is applied at the MRP;

c) for applied frequencies of 4,65; 5,0; 6,0; 6,5; 7,0; 7,5 kHz, the level of the corresponding image frequency is measured.

15.24 Out of band (receiving)

See subclause 7.6.2 of ETS 300 175-8 [8].

A digital signal generator, or an analogue signal generator followed by an ideal codec, is connected to point B of the ReFP as shown in figure 37 or to the S-reference point of a FP, and is set to provide a signal level of 0 dBm0 at the uniform PCM reference point D.

For input signals at the frequencies 500 Hz, 1 000 Hz, 2 000 Hz, and 3 150 Hz, the level of the corresponding image signals at frequencies up to 8 kHz is measured at the ear reference point.

15.25 Sending noise

See subclause 7.7.1 of ETS 300 175-8 [8].

The PP shall be mounted at the LRGP and the earpiece sealed to the knife-edge of the artificial ear in an acoustically quiet environment (ambient noise less than 30 dBA).

A digital measuring instrument, or an ideal codec followed by an analogue level measuring set, is connected to point A of the ReFP as shown in figure 37, or to the S-reference point of a FP.

The noise level at the PCM interface point A is measured using psophometric weighting as described in CCITT Recommendation G.223 [19], table 4.

15.26 Sending noise (narrow band)

See subclause 7.7.2 of ETS 300 175-8 [8].

The PP shall be mounted at the LRGP and the earpiece sealed to the knife-edge of the artificial ear in the Low Noise Room (LNR).

An ideal codec followed by a selective measuring set or spectrum analyser with an effective bandwidth of 10 Hz is connected to point A of the ReFP as shown in figure 37, or to the S-reference point of a FP.

The rms voltage of the 10 Hz band limited signal is measured within the frequency range 305 Hz to 3 395 Hz.

15.27 Receiving noise

See subclause 7.7.3 of ETS 300 175-8 [8].

A digital signal generator, or an analogue signal generator followed by an ideal codec, is connected to point B of the ReFP as shown in figure 37, or to the S-reference point of a FP, and is set to provide a signal corresponding to decoder value number 1 at the uniform PCM reference point D.

With an ambient noise level not exceeding 30 dBA, the noise level in the artificial ear is measured.

15.28 Sampling frequency level (receiving)

See subclause 7.7.4 of ETS 300 175-8 [8].

A digital signal generator, or an analogue signal generator followed by an ideal codec, is connected to point B of the ReFP as shown in figure 37, or to the S-reference point of a FP, and is set to provide a signal corresponding to decoder value number 1 at the uniform PCM reference point D.

With an ambient noise level not exceeding 30 dBA, the level of any 8 kHz signal in the artificial ear is measured.

15.29 Acoustic shock

See subclause 7.8 of ETS 300 175-8 [8].

15.29.1 Continuous signal

The handset is mounted in the LRGP and the earpiece is sealed to the knife-edge of the artificial ear.

A digital signal generator is connected at the digital interface. It is set to deliver the digitally encoded equivalent of a square wave, with a peak code equal to the maximum code which can be sent over the digital interface at frequencies in third-octave intervals as given by the R.10 series of preferred numbers in ISO Publication 3 [28] for frequencies from 200 Hz to 4 kHz. For each frequency, the sound pressure in the artificial ear shall be measured.

15.29.2 Peak signal

Compliance shall be by manufacturer's declaration, until a test method has been specified.

15.30 DECT network delay

See subclause 7.9.1 of ETS 300 175-8 [8].

This test shall only apply when testing a FP and a PP as a pair.

15.30.1 FP connected to a network with a digital 4-wire interface

a) The PP is mounted in the LRGP and the earpiece is sealed to the knife-edge of the artificial ear. A frequency response analyser is connected to the artificial ear and voice as shown in figure 38. The ARL is applied at the MRP;

b) the FP is arranged to provide a direct loopback of the PCM signal at the S-interface, corresponding to points A and B of figure 37;

NOTE: This loopback function is unlike the test loopback feature provided in the MAC layer, ETS 300 175-3 [3].

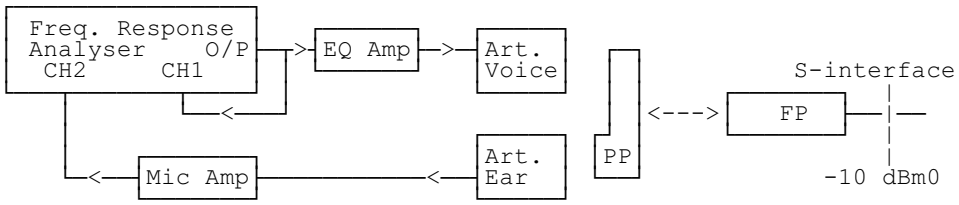


Figure 38: DECT network delay test configuration

c) for each of the nominal frequencies (f 0) given in the table below in turn, the delay is derived from the measurements at the corresponding values of f1 and f2;

Table 16: Frequencies for delay measurement

f0 (Hz)	f1 (Hz)	f2 (Hz)
500,0	495,0	505,0
630,0	625,0	635,0
800,0	795,0	805,0
1 000,0	995,0	1 005,0
1 250,0	1 245,0	1 255,0
1 600,0	1 595,0	1 605,0
2 000,0	1 995,0	2 005,0
2 500,0	2 495,0	2 505,0

d) for each value of f0, the delay is evaluated as follows:

d_1) output the frequency f1 from the frequency response analyser;

d_2) measure the phase shift in degrees between CH1 and CH2 (P1);

d_3) output the frequency f2 from the frequency response analyser;

d_4) measure the phase shift in degrees between CH1 and CH2 (P2);

d_5) compute the delay in milliseconds using the formula:

$$D = [1\,000 \times (P1 - P2)] / [360 \times (f2 - f1)].$$

e) the network delay (PP and FP combined) shall be assumed to be the mean value of the 8 measured delay values of D.

The network delay shall not exceed 27,5 ms.

The above test assumes the FP to have a maximum loop-back delay of the PCM bits of 125 µs.

The radio signal propagation delay in the air and in the radio circuits is typically in the order of 5 µs and is thus negligible.

15.30.2 Network with an FP with an analogue 4-wire interface

The FP shall be tested according to subclause 15.30.1, or if loopback is not possible at the PCM interface, the loopback shall be made at the analogue interface and D shall not exceed 28 ms.

15.30.3 Network with an FP with an analogue 2-wire interface

The FP shall be tested according to subclause 15.30.1, or if loopback is not possible at the PCM interface, the loop-back shall be made at the analogue interface and D shall not exceed 28 ms.

The manufacturer shall declare that the delay including the 4-wire to 2-wire hybrid does not exceed 28 ms.

If only the 2-wire interface is accessable for loop-back, the loop-back shall be performed via an external 2- to 4-wire hybrid circuit.

15.31 PP delay

See subclause 7.10.2 of ETS 300 175-8 [8].

a) The PP is mounted in the LRGP and the earpiece is sealed to the knife-edge of the artificial ear. A frequency response analyser is connected to the artificial ear and voice as shown in figure 39. The acoustic reference level is defined as the acoustic level which corresponds to a power level of -10 dBm0 at the digital interface;

b) the ReFP is arranged to provide a direct 5 ms delay loopback of the ADPCM signal. This shall be done using the MAC layer loopback test message, ETS 300175-3 [3];

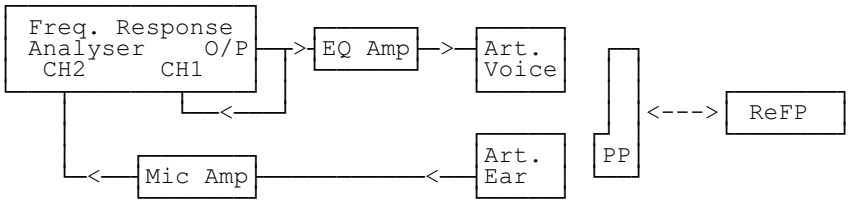


Figure 39: PP delay test configuration

c) for each of the nominal frequencies (f 0) given in the table below in turn, the delay is derived from the measurements at the corresponding values of f1 and f2;

Table 17: Frequencies for delay measurement

f0 (Hz)	f1 (Hz)	f2 (Hz)
500,0	495,0	505,0
630,0	625,0	635,0
800,0	795,0	805,0
1 000,0	995,0	1 005,0
1 250,0	1 245,0	1 255,0
1 600,0	1 595,0	1 605,0
2 000,0	1 995,0	2 005,0
2 500,0	2 495,0	2 505,0

d) for each value of f 0, the delay is evaluated as follows:

d_1) output the frequency f1 from the frequency response analyser;

d_2) measure the phase shift in degrees between CH1 and CH2 (P1);

d_3) output the frequency f2 from the frequency response analyser;

d^4) measure the phase shift in degrees between CH1 and CH2 (P2);

d5) compute the delay in milliseconds using the formula:

$$D = [1\,000 \times (P1 - P2)] / [360 \times (f2 - f1)].$$

e) the PP delay shall be assumed to be the mean value of the 8 measured delay values of D.

The above test assumes the ReFP to have a 5,0 ms loop-back delay of the bits of received ADPCM bursts.

The value 5,0 ms gives an accuracy of ± 50 µs. The radio signal propagation delay in the air and in the radio circuits is typically in the order of 5 µs and is thus negligible.

15.32 FP delay

See subclause 7.9.3 of ETS 300 175-8 [8].

15.32.1 Digital 4-wire interface

a) The FP is connected to the measurement equipment as shown in figure 40. The level of the signal from the analyser shall be adjusted to give - 10 dBm0 at the S-interface;

b) the RePP is arranged to provide a direct 5ms delay loopback of the ADPCM signal. This shall be done using the MAC layer loopback test message ETS 300 175-3 [3];

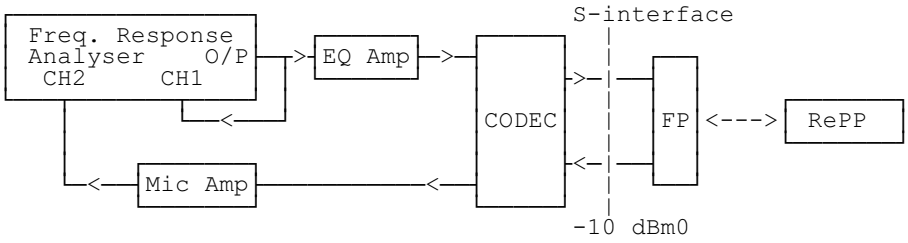


Figure 40: FP delay test configuration

c) for each of the nominal frequencies (f0) given in the table below in turn, the delay is derived from the measurements at the corresponding values of f1 and f2;

Table 18: Frequencies for delay measurement

f0 (Hz)	f1 (Hz)	f2 (Hz)
500,0	495,0	505,0
630,0	625,0	635,0
800,0	795,0	805,0
1 000,0	995,0	1 005,0
1 250,0	1 245,0	1 255,0
1 600,0	1 595,0	1 605,0
2 000,0	1 995,0	2 005,0
2 500,0	2 495,0	2 505,0

d) for each value of f0, the delay is evaluated as follows:

d_1) output the frequency f1 from the frequency response analyser;

d_2) measure the phase shift in degrees between CH1 and CH2 (P1);

d_3) output the frequency f2 from the frequency response analyser;

d_4) measure the phase shift in degrees between CH1 and CH2 (P2);

d_5) compute the delay in milliseconds using the formula:

$$D = [1\,000 \times (P1 - P2)] / [360 \times (f2 - f1)].$$

e) the FP delay shall be assumed to be the mean value of the 8 measured delay values of D.

The FP delay shall not exceed 19 ms.

The above test assumes the RePP to have a 5,0 ms loop-back delay of the bits of received ADPCM bursts.

The value 5,0 ms gives an accuracy of ± 50 µs. The radio signal propagation delay in the air and in the radio circuits is typically in the order of 5 µs and is thus negligible.

15.32.2 Analogue 4-wire interface

The FP shall be tested as in subclause 15.33.1, if the S-interface is available. If it is unavailable, test equipment shall be connected directly to the analogue 4-wire interface without any codec and D shall not exceed 19,5 ms.

15.32.3 Analogue 2-wire interface

15.32.3.1 If a 4-wire interface point is accessible

The FP shall be tested as in subclause 15.32.1 and meet the verdict criteria described therein. In addition, the manufacturer shall declare that the delay including the 2- to 4-wire hybrid does not exceed 19,5 ms.

15.32.3.2 If only a 2-wire interface point is accessible

The FP shall be tested as in subclause 15.32.1, however, an (analogue) 2- to 4-wire hybrid circuit replaces the codec. D shall not exceed 19,5 ms.

15.33 Network echo control

See subclause 7.10 of ETS 300 175-8 [8].

It shall be possible to disable every echo control function implemented in the FP. During this test, the echo control device specified in ETS 300 175-8 [8], subclause 7.4.1.2 b) shall be disabled. The manufacturer shall declare to the test authority how this is done.

15.33.1 4-wire interface

A signal source shall be connected to the input of the S-interface of the RePP and a level measuring set shall be connected to the output of the S-interface of the RePP.

The signal source is a digital signal derived from the CCITT Recommendation P.50 speech spectra [30] assuming a flat sending frequency response of the RePP. Five measurements shall be made at each of the input signal levels, L_{in} of - 10, - 20 and - 25 dBmO at the S-interface of the RePP. The mean dB value at each signal level shall be taken.

The S-interface of the FP shall be connected to a delay circuit. The signal is looped back to produce a wanted Echo Loss, LE = 15 dB. See figure 41. For an analogue 4-wire interface, the loss measured at the S-interface of the RePP shall be 15 dB, when the echo control of the FP is disabled.

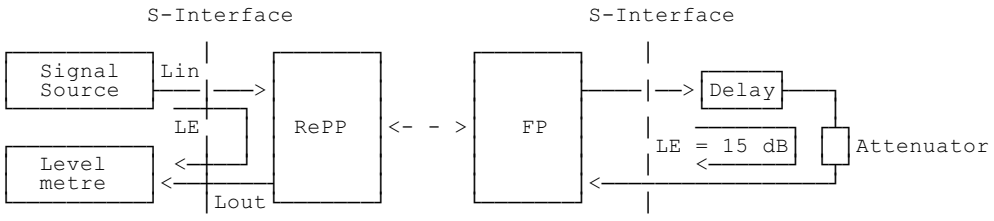


Figure 41: FP with 4-wire interface

For each signal level, the input signal shall be applied for more than 2 seconds before L_{out} is measured.

For any combination of input levels, L_{in} and the delays 0 ms, 20ms and 70 ms, the Echo Loss , LE at the S-interface of the RePP shall be at least 15 + 9 dB = 24 dB. The Echo Loss LE, is calculated according to CCITT Recommendation G.122 [17].

If no RePP is available for testing, a suitable accessible PCM reference point in the FP may be used if such a point is not accessible in the PP. If such a point is not accessible in the PP or FP, the PP is placed in the LRGP and white noise is applied at the MRP. The input signal levels shall be adjusted to correspond to the levels specified for the S-interface of the RePP assuming that SLR_H = 7dB. Talker's Echo Loudness

Rating (TELR), shall be measured instead of the Echo Loss, LE, of the RePP. The formula TELR = LE (RePP) + 10 dB shall be used.

15.33.2 Analogue 2-wire interface

The local DECT system has to meet the SLR and RLR requirements of the national authority. The FP gain controls of the input and output signals have to have been adjusted to meet these requirements assuming that a PP has SLR_H = 7 dB and RLR_H = 3 dB referred to a reference PCM point in the PP.

15.33.2.1 Requirement 1

The measurement is made with the time dispersion inherent in the 2-/4-wire hybrid circuit and in the terminating cable equivalent. No extra delay is introduced in the cable equivalent circuitry. The manufacturer shall declare that the control range of the echo control device is not less than 4 ms.

A signal source shall be connected to this input of the S-interface of the RePP and a level measuring set shall be connected to the output of the S-interface of the RePP.

The signal source is a digital signal derived from the CCITT Recommendation P.50 [30] speech spectra assuming a flat sending frequency response of the RePP. Five measurements shall be made at each of the input signal levels, L_{in} of - 10, - 20 and - 25 dBmO at the S-interface of the RePP. The mean dB value at each signal level shall be taken.

The 2-wire interface of the FP shall be terminated by an impedance Z. See figure 42.

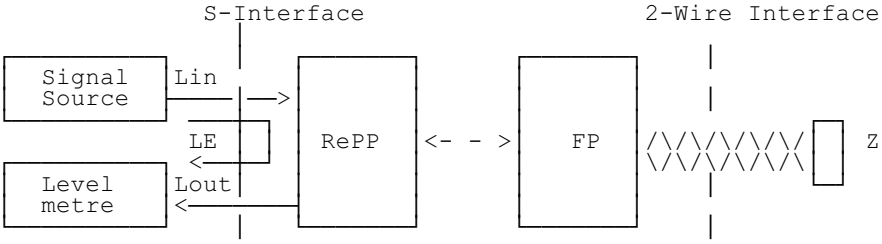


Figure 42: FP with analogue 2-wire interface

The input signal L_{in}, shall for each level be applied for at least 2 seconds before L_{out} is measured. The extra echo loss of requirement 2 (see subclause 15.33.2.2 of this document, and subclause 7.10 of ETS 300 175-8 [8]) shall be set to the lowest value that can be selected according to routing information.

For any combination of input signal levels, L_{in} and values of Z given by the national authority, the echo loss, LE, shall be at least 14 dB (LE = TELR - SLRH - RLRH $\geq$ 24 - 10 dB). The Echo Loss, LE, is calculated according to CCITT Recommendation G.122 [17].

If no RePP is available for testing, a suitable accessible PCM reference point in the FP may be used if such a point is not accessible in the PP. If such a point is not accessible in the PP or FP, the PP is placed in the LRGP with its sidetone disconnected and white noise is applied at the MRP. The input signal levels shall be adjusted to correspond to the levels specified for the S-interface of the RePP assuming that SLR_H = 7 dB. Talker's Echo Loudness Rating, TELR, shall be measured instead of the Echo loss, LE, of the RePP. The formula TELR = LE (RePP) + 10 dB shall be used.

NOTE: Proper values of Z are given by cable equivalents and termination impedances specified for test of the sidetone requirement for analogue telephones. The values of Z, SLR and RLR for a country may differ for connection to a public extension and a Private Automatic Branch Exchange (PABX) extension, subject to future standardisation. One set of values for Z could be used to verify the echo control function.

15.33.2.2 Requirement 2

If the option is available to reduce or disable the extra echo loss for Requirement 2 (see subclause 7.10 of ETS 300 175-8 [8]) depending upon routing information the manufacturer shall declare to the test authority how this is done.

A signal source shall be connected to this input of the S-interface of the RePP and a level measuring set shall be connected to the output of the S-interface of the RePP.

The signal source is a digital signal derived from the CCITT Recommendation P.50 speech spectra [30] assuming a flat sending frequency response of the RePP. Five measurements shall be made at each of the input signal levels, L_{in} of - 10, - 20 and - 25 dBmO at the S-interface of the RePP. The mean dB value at each signal level shall be taken.

The 2-wire interface of the FP shall be terminated by an impedance Z. See figure 42.

The 2-wire interface of the FP is connected to a matched 2-wire to 4-wire hybrid circuit providing the nominal load Z at the 2-wire interface. (See figure 43). The 4-wire side is connected to a circuit providing 70 ms delay. The signal is looped back to provide an echo. The attenuator of the termination is adjusted to give an Echo Loss, LE, of 15 dB at the RePP when the echo control functions of the FP are disabled.

The echo control functions for requirements 1 and 2 are reactivated. The input signal, L_{in}, shall for each level be applied for at least 2 seconds before L_{out} is measured. The output level L_{out}, is measured during a time window of 20-70 ms from the switch-off time of the input L_{in}. L_{in} shall be below 50 dBmO, 10 ms after the switch-off time.

The Echo Loss LE, shall be at least 24 dB for any of the specified levels of L_{in}. The Echo Loss, LE, is calculated according to CCITT Recommendation G.122 [17].

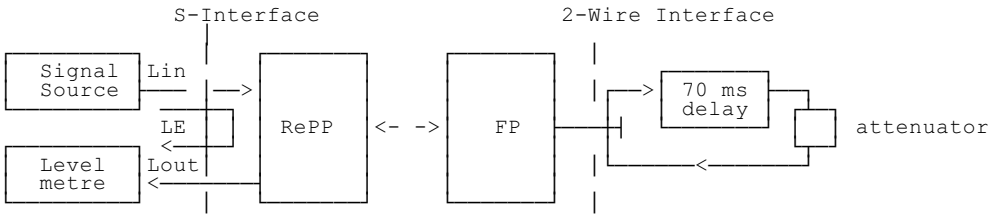


Figure 43: FP with analogue 2-wire interface

If a RePP is not available for testing, a suitable accessible PCM reference point in the FP may be used if such a point is not accessible in the PP. If such a point is not accessible in the PP or FP, the PP is placed in the LRGP with its sidetone disconnected and white noise is applied at the MRP. The input signal levels shall be adjusted to correspond to the levels specified for the S-interface of the RePP assuming that SLR_H = 7dB. TELR shall be measured instead of the Echo Loss, LE, of the RePP. The formula TELR = LE (RePP) + 10 dB shall be used.

15.34 PP ambient noise rejection

See subclause 7.11 of ETS 300 175-8 [8].

15.35 Loudspeaker and hands-free facilities

See subclause 8.1 of ETS 300 175-8 [8].

This compliance test will be determined when the performance requirements have been defined.

16 Requirements for public access

These requirements have been taken from ETS 300 175-9 [9]. Any revisions to ETS 300 175-9 [9] shall take precedence over this Clause.

Apparatus for which DECT public access service compliance is claimed shall comply with all the technical requirements of this section identified as provision mandatory. Individual process mandatory requirements must be satisfied on any apparatus claiming provision of particular facilities additional to those identified as provision mandatory requirements.

The manufacturer shall declare compliance to the public access service requirements until such time as appropriate test methods have been defined.

16.1 Description of the features

16.1.1 Speech

Circuit-mode 32 kbit/s unrestricted 8 kHz structured bearer service category suitable for speech information transfer (CCITT Recommendation G.721 ADPCM speech encoding [16]).

16.1.2 Bell on

Activates bell or other user indication controlling process at the target apparatus.

16.1.3 Bell off

Deactivates bell or other user indication controlling process at the target apparatus.

16.1.4 Off-hook

The ability to indicate the action of going off-hook, e.g. to start call set-up or accept a call.

16.1.5 On-hook (full release)

The ability to indicate the action of going on-hook, (e.g. to terminate a call) and fully release the radio resource.

16.1.6 Partial release

The ability to release an established call whilst retaining the radio resource for the purpose of accessing further services.

16.1.7 Dialled digits (basic)

The capability to dial digits 0-9, *, #.

16.1.8 Dialled digits (additional)

The capability to dial digits A, B, C, D (in addition to the basic digits).

16.1.9 Dialling delimiter

A means to generate or otherwise to indicate "end-of-destination-address" when dialling or transmitting dialled digits.

16.1.10 Dialling delimiter request

The ability to advise that a dialling delimiter is required.

16.1.11 Register recall

To hold existing call and seize a register (with dial tone) to permit input of further digits or other action.

16.1.12 Go to Dual Tone Multi-Frequency

Go to DTMF signalling, with optional indication of DTMF tone duration.

16.1.13 Go to pulse

Go to pulse (decadic) signalling.

16.1.14 Pause (interdigit pause)

The ability to generate or indicate an inter-digit pause, e.g. to await further dial tone.

16.1.15 Specific trunk carrier selection

The ability to select a specific trunk carrier for a call through a global network.

16.1.16 Incoming call

A call received at a DECT PP.

16.1.17 Hold call

The ability to hold calls while other services are accessed.

16.1.18 Re-connection of a held call

The re-connection of a previously held call.

16.1.19 Forced re-connection

The forced re-connection of a call which has been left on hold for an excessive period of time.

16.1.20 Authentication of portable part

The process by which the identity of a DECT portable part is checked by the fixed part.

The standard (common) authentication algorithm must be built-in to the PP.

The standard (common) authentication algorithm must be accepted for authentication of roaming public access service portable part.

User Authentication Key (UAK) and Authentication Code (AC) to be supported.

Time from initial request for service to completion of successful authentication process shall not exceed 2 seconds.

16.1.21 Authentication of user

The process by which the identity of a DECT user is checked by the fixed part.

The User Personal Identification (UPI), a personal identification of 4 to 8 digits, manually entered by the user via the keypad, is used for user authentication.

16.1.22 Authentication of fixed part

The process by which the identity of a fixed part is checked by the portable part.

It is optional to support the authentication of FT in both the PT and FT. If, however, ZAP, key management or PP data amendment is implemented in the FT, then it is mandatory in the FT to support authentication of FT. The process is the same as that defined for authentication of PT.

UAK and Authentication Code (AC) to be supported. Note they are the same as those for PT, but different for each operator.

16.1.23 Silent polling

The ability of a DECT fixed part to establish whether a specific portable part is within range without alerting the user of that portable part.

16.1.24 Class of service field indication

Indication to the fixed part by the portable part of the contents of its class-of-service field. The information passed across may vary depending on the system/network/service provider with whom communication is currently made, as class-of service may vary from one subscription to the other.

16.1.25 Inter-operator roaming registration

The ability to exchange inter-operator roaming data in real time over the air interface during the first call-attempt between the portable part of a subscriber of a home DECT service provider A and the FP of a visited DECT service provider B, assuming A and B have agreed to offer inter-operator roaming to their respective subscribers.

16.1.26 Control of supervisory tones

Control of a variety of supervisory (call progress) tones, which may be generated in the portable part.

For the public access service, network supervisory signals shall be made available in-band to the portable part by the fixed part, either by relay from the global or extended services network, or by local generation at the portable part.

The provision of a tone generator is optional for public access service portable parts.

16.1.27 Regular security handshake

Regular interchange of information (link identifier) between portable part and fixed part during the period between link initiation and link termination to maintain link in normal operation and to reject unauthorised attempts to seize link. Interchange at intervals of the order of 1 second is acceptable.

16.1.28 Signalling of display characters

The transmission to the portable part of characters to be displayed on the user's portable part display (if provided).

16.1.29 Display control characters

Characters sent to the portable part to control the user's display in the portable part (if provided). Such characters include cursor control, clear screen, home, flash, inverse video etc.

16.1.30 ZAP suspend

The ability to re-program the account data held in the portable part so that access rights are suspended subject to other the conditions being met, coupled with the ability to re-program the account data again to reinstate access rights once these conditions have been met. One ZAP field shall be provided per account field. The portable part has the right to authenticate the fixed part.

16.1.31 ZAP terminate

The ability to re-program the account data held in the portable part so that access rights are terminated and cannot be reinstated except by following a full re-registration procedure. Applications for this include the case where a portable part requests access after a subscription has been cancelled or after the portable part has been reported as lost or stolen. The portable part has the right to authenticate the fixed part.

16.1.32 Alphanumeric text messaging and radiopaging service

The ability to send short messages consisting of up to 120 characters of the default or other character set or initiate tones when not in-call or when in-call, with or without acknowledgement.

16.1.33 Voice and user data traffic encryption activation/deactivation

The activation or deactivation of the encryption process applied to voice or user data on the traffic channel.

NOTE: This feature can be with signalling traffic encryption using a common encryption process.

16.1.34 Signalling traffic encryption activation/de-activation

The activation or deactivation of the encryption process on signalling information.

NOTE: This feature can be with voice and data traffic encryption using a common encryption process.

16.1.35 Debit public access service

A public access service system run on the basis of a portable part being pre-loaded by some method with call-value for the system. A secure method of decrementing the call-value from the fixed part, under the control of the public access service operator, is required.

16.1.36 Credit public access service

A public access service system run on the basis of a portable part being loaded by some means with identification data sufficient to enable the service provider to securely establish the account to which call charges are to be attributed.

16.1.37 Credit agency public access service

A public access service system run on the basis of a portable part being loaded by some means with identification data sufficient to enable the service provider to securely establish the account with a credit agency to which call charges are to be attributed.

16.1.38 On-demand (hot-bill) public access service

A public access service system run on the basis of a portable part being loaded by some means with identification data sufficient to enable the service provider to securely establish the account to which call charges are to be attributed. At a billing point, the system must be able to provide a bill for call charges accrued, on demand.

16.1.39 Advice of tariff request

The ability for the user to request an indication of the call tarif. The indication may be given by visual, audible or other means.

16.1.40 Advice of charge request

The ability for the user to request an indication of call charge for all or particular calls.

16.1.41 Location registration for incoming calls, paging or messages

A facility whereby a portable part can be registered with a fixed part or a cluster of FPs such that incoming calls, radio pages or messages may be routed to it.

16.1.42 Location de-registration for incoming calls, paging or messages

A facility whereby a Portable Part (PP) can be de-registered with a fixed part or a cluster of fixed parts.

16.1.43 Queue management

A facility to register in a queue, having been given a network congestion indication. Feed-back at regular intervals of information of how the queue is progressing may be provided by the alphanumeric messaging facility.

16.1.44 Queue entry request

Request to enter outgoing call queue.

16.1.45 Queue exit request

Request to exit the outgoing call queue.

16.1.46 "Portable part inaccessible" indication

An indication, based on information derived within the DECT fixed part to indicate that the called DECT portable part cannot be contacted (not attached, not present, or powered down). This may be used to provide indication to the caller in some manner (e.g. by recorded message) that the call cannot be completed.

16.1.47 "In-range" indication

A means of indicating to a portable part, without necessarily establishing a full two-way radio link, that it is within range of a fixed part to which it might wish to gain access.

16.1.48 Emergency service access request

A functional mode request for call set-up to the emergency service.

It must be possible for the fixed part to discriminate an emergency service access request from non-emergency service access requests in order to ensure that it is possible to by-pass the normal call validation and establishment mechanisms if desired.

16.1.49 Indication of teleservices available request

Request to be given an indication of range of teleservices available at a given location.

16.1.50 Indication of teleservices available

Indication of the range of teleservices available at a given location.

16.1.51 Selection of service provider/network operator

The ability to signal the identity of the desired service provider or network operator with which it is desired to communicate when setting up a call at a particular moment in time.

16.1.52 Selection of required teleservice

The ability to select a particular teleservice which is required at a given moment.

16.1.53 Selection of bearer service

The ability to select a particular bearer service for a particular application for the duration or part of the duration of an individual call.

16.1.54 Validation of portable part user

The process carried out by the DECT system/network to identify the class-of-service to be made available to an authenticated DECT user. This feature activates the class of service field indication.

16.1.55 Validation of portable part

The process carried out by the DECT system/network to identify the class-of-service to be made available to an authenticated DECT portable part. This feature activates the class of service field indication.

16.1.56 Validation of identity module

The process carried out by the DECT system/network to identify the class-of-service to be made available to an authenticated DECT authentication module. This feature activates the class of service field indication.

16.1.57 User identification

The UPI, a personal identification of 4 to 8 digits, manually entered by the user via the keypad, used for user authentication only, which (having been operated on by the authentication key) generates an authentication result which is then passed over the radio interface and for example used to identify a user to a service provider. See authentication of user, subclause 16.1.21.

16.1.58 Group address

The ability to address a group of portable parts for the purposes of simultaneous announcements e.g. through loudspeaking telephones.

16.1.59 Selection of additional character sets

The ability to select additional character sets.

16.1.60 Data capability

The ability to transmit and receive data traffic over a communications channel.

16.1.61 Keypad protocol for supplementary services

A protocol used to invoke supplementary services offered by the network to which DECT is interconnected.

16.1.62 Feature key management protocol for supplementary services

A protocol used to invoke supplementary services offered by the network to which DECT is interconnected.

16.1.63 Functional protocol for supplementary services

A protocol used to invoke supplementary services offered by the network to which DECT is interconnected.

16.1.64 Dial tone detection indication

The ability to indicate to the portable part from the fixed part the detection of dial tone.

16.1.65 Request for indication of (temporary) subscriber number

A request to indicate (visually or audibly) to the user the temporary subscriber number allocated to the user during a temporary registration on (for example) a network, other than the usual or home network, to which the user has access rights.

16.1.66 Portable part capability/fixed part capability data exchange

The ability for a portable part and a fixed part to exchange data on their respective capabilities so that each can establish the mutual subset which they have in common.

16.1.67 Subscription registration user procedure (on-air)

A standardised procedure for loading subscription registration data into a portable part in real time over the air-interface.

16.1.68 Subscription registration user procedure (keypad)

A standardised procedure for loading subscription registration data into a portable part using the keypad.

16.1.69 Subscription registration user procedure (DECT authentication module)

A standardised procedure for loading subscription registration data into a portable part using the DECT authentication module.

16.1.70 Subscription data exchange (on-air)

The ability to exchange subscription data between a network and a portable part in real-time over the air interface.

A secure subscription service shall be provided.

16.1.71 Multicell fixed part coverage

The ability of DECT to provide coverage using a fixed part comprising two or more cells with intercommunicating radio end points.

16.1.72 Handover

16.1.72.1 Description

The action of switching a call in progress from one or more physical channels to other physical channel. There are two forms of handover, intra-cell handover and inter-cell handover.

Intra-cell handover: the switching of a call;
in progress from one or more physical channels;
of one cell to other physical;
channels of the same cell.

Inter-cell handover: the switching of a call;
in progress from one cell to another cell.

16.1.72.2 Bearer handover test procedure (portable parts only)

Receipt of the "force bearer handover" message causes the IUT to immediately execute its' bearer handover procedure. The destination for the new bearer shall be selected from the IUTs' channels list.

The "force bearer handover" message makes no reference to a particular slot or frequency. Its' purpose is to force the IUT to execute its' bearer handover procedure. After receipt and execution of the message, the IUT will return to the test standby mode.

Refer to subclause 7.2.5.4 of ETS 300 175-3 [3] for details on the test messages and to subclause 10.5.1.1 of ETS 300 175-3 [3] for details on the basic connection control messages specified in this procedure.

16.1.72.3 Test environment

The test shall take place at a test site or in a test fixture.

If the IUT has an antenna connector then it shall be used to connect the IUT to the LT.

The test shall take place under nominal supply voltages and temperatures.

16.1.72.4 Method of verification

a) A minimum of one duplex bearer shall be set-up between the LT and the IUT;

b) the LT shall issue a "force bearer handover" test message to the IUT;

c) the LT will start a 10 second Transfer Timer;

d) on receipt of a BEARER_HANDOVER_REQUEST message from the IUT for a new bearer, the LT will issue a SETUP_CONFIRM message to the IUT;

e) the IUT then sends a connection control message (eg, BEARER_CONFIRM, WAIT, etc.) to the LT;

f) the LT responds with the appropriate connection acknowledge message to the IUT;

g) the LT will then send a RELEASE message to the IUT indicating termination of the old bearer;

h) the LT begins transmission of MAC layer control messages in the first half of the DECT frame to the IUT;

i) the IUT begins transmission of MAC layer control messages in the second half of the DECT frame to the LT;

j) the test will terminate on either the IUT transmitting NT messages on the new bearer to the LT or expiration of the LT Transfer Timer.

16.1.72.5 Verdict criteria

The IUT shall transmit N_T messages (ETS 300 175-3 [3]) on a different slot and/or frequency to the LT before expiry of the Transfer Timer.

16.1.73 Multiple subscription registration

The ability for the portable part to retain details of more than one subscription.

16.1.74 All-physical-channel capability

The capability of portable parts and fixed parts to operate on all DECT physical channels.

16.2 Summary of DECT public access service facilities

Those facilities listed below which are indicated as provision mandatory in either the portable part, or fixed part, or both, represent the minimum public access service facility set.

Table 19

M Mandatory
O Optional
- Not Applicable

		Provision FP	Provision PP	
0	Outgoing call	M	M	
1	Duplex speech - 32 kbit/s ADPCM	M	M	
2	Bell on	O	O	(bell on/bell off shall be
3	Bell off	O	O	implemented as a pair)
4	Off hook	M	M	
5	On hook (Full Release)	M	M	
6	Partial release	M	O	
7	Dialled digits basic	M	M	
8	Dialled digits additional	O	O	
9	Dialling delimiter	O	O	
10	Dialling delimiter request	O	O	
11	Register recall	O	O	
12	Go to DTMF	M	O	
13	Go to pulse	O	O	
14	Pause	O	O	
15	Specific trunk carrier selection	O	O	
16	Incoming call facility	O	O	
17	Hold call	O	O	(hold call/re-connection of
18	Re-connection of held call	O	O	held call shall be implemented as a pair)
19	Forced re-connection of held call	O	O	
20	Authentication of portable part	M	M	
21	Authentication of user	O	M	Using UPI
22	Authentication of fixed part	M	O	Provision mandatory in FP if ZAP, key management or other PP data amendment feature implemented. Provision in PP recommended
23	Silent polling	O	O	
24	Class of service field indication	M	M	
25	Inter-operator roaming registration	O	M	
26	Control of supervisory tones	M	O	Provision mandatory only in fixed parts attached to networks offering out-of-band signalling
27	Regular security handshake	M	M	
28	Signalling of display characters	O	O	
29	Display control characters	O	O	
30	ZAP suspend	O	M	
31	ZAP terminate	O	M	
32	Alphanumeric text messaging and radiopaging service	O	O	
33	Voice/user data encryption activation/de-activation	O	O	
34	Signalling encryption activation/de-activation	O	O	
35	Debit public access service	O	O	
36	Credit public access service	O	O	
37	Credit agency public access service	O	O	
38	On-demand (hot-bill) public access service	O	O	
39	Advice of tariff request	O	O	
40	Advice of charge request	O	O	
41	Location registration	O	O	
42	Location de-registration	O	O	Provision mandatory if, location registration for incoming calls is applied

(continued)

Table 19 (concluded)

		Provision FP	Provision PP	
43	Queue management	O	O	
44	Queue entry request	O	O	
45	Queue exit request	O	O	
46	Portable part inaccessible indication	O	-	Indicate to IWU that call cannot be connected.
47	In-range indication	O	O	
48	Emergency service access request	M	M	
49	Indication of teleservice available request	O	O	
50	Indication of teleservices available	0	O	
51	Selection of service provider/ network operator	M	M	
52	Selection of required teleservice	O	O	
53	Selection of bearer service	O	O	
54	Validation of portable part user	M	-	
55	Validation of portable part	M	-	
56	Validation of identity module	O	-	
57	User identification (UPI)	O	M	
58	Group address	O	O	
59	Selection of additional character sets	O	O	
60	Data capability	O	O	
61	Keypad protocol	M	M	
62	Feature key management protocol	O	0	
63	Functional protocol	O	O	
64	Dial tone detection indication	O	O	
65	Request for indication of temporary subscriber number	O	O	
66	Fixed part/portable part capability exchange	M	M	
67	Subscription registration user procedure on-air plus digit entry	M	M	
68	Subscription registration user procedures keypad (digit entry only)	O	O	
69	Subscription registration user procedure with DECT authentication module	O	O	
70	Subscription data exchange (on-air)	M	M	
71	Multicell fixed part coverage	O	M	
72	Handover (Implicit in basic DECT)			
	- Intra-cell	M	M	
	- Inter-cell	O	M	
73	Multiple subscription registration	-	M	
74	All-physical-channel capability	M	M	

Annex A (informative): Report references

[1] Construction of a Stripline: "Technical Report FTZ N^{o} 512 TB 9".

[2] Construction of an Anechoic Chamber: "Technical Report ZVEI AK-R 90/20".

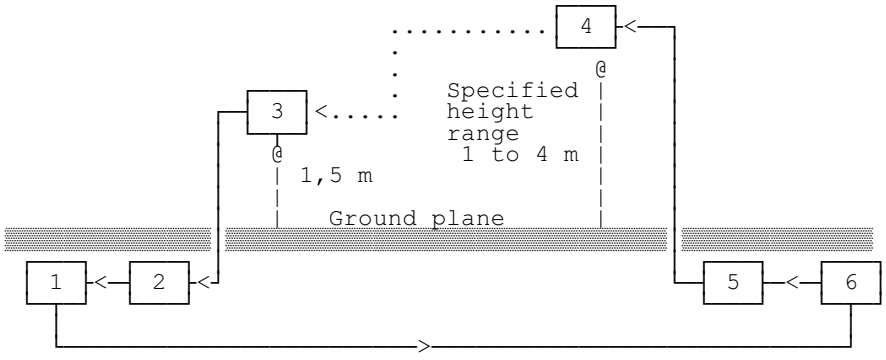
[3] IEC Publication 489-3 Second edition (1988) Appendix F, pages 130 to 133.

Annex B (normative): Procedures for test fixture calibration and for measurement of radiated spurious emissions

B.1 Calibration of test fixture for receiver measurements

The calibration procedure utilises the average measured usable sensitivity of the receiver. 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^{-3}, when the receiver is rotated in 45° increments, starting at the reference orientation.

B.1.1 Method of measurement



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

Figure B.1: Measurement arrangement N° 1

a) A **test site** which fulfills 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.

A signal generator capable of producing a DECT signal 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 applicant, 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^{-3} 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 Xi(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:

$$X_{mean} = 20 \log \left[\frac{8}{\sum_{i=1}^{i=8} (1/X_i^2)} \right]^{1/2}$$

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;

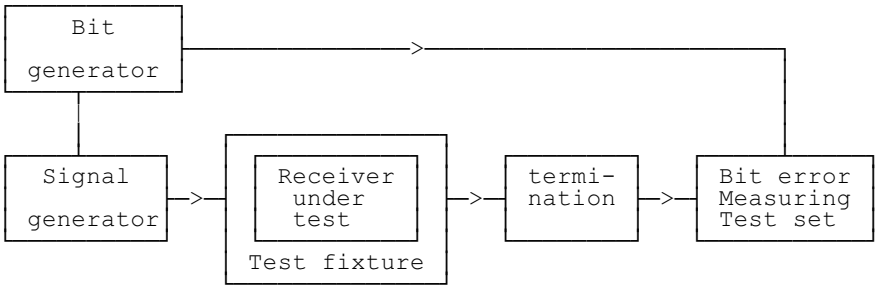


Figure B.2: Measurement arrangement N° 2

k) the test signal input level providing a bit error ratio of 10^{-3} 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.

B.2 Radiated measurements

B.2.1 General

This Annex 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 Annex 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.

B.2.2 Radiated spurious emissions

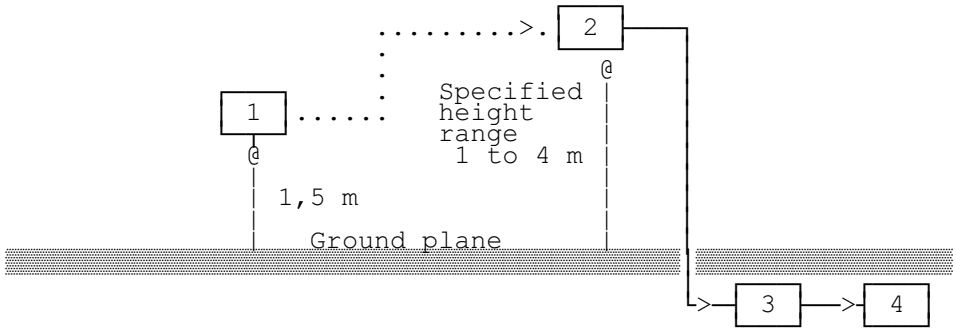
B.2.2.1 Definition

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.

B.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 B.3: 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 is 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.

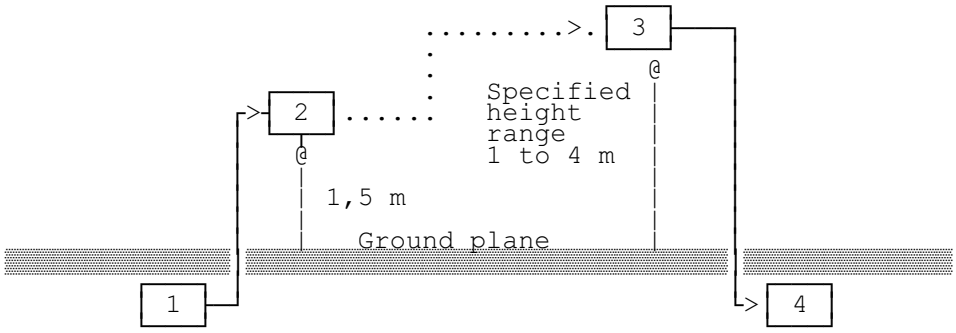
The transmitter under test shall be placed on the support in its **standard position** and shall be switched on without modulation;

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 B.4: 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.

B.2.3 Cabinet radiation

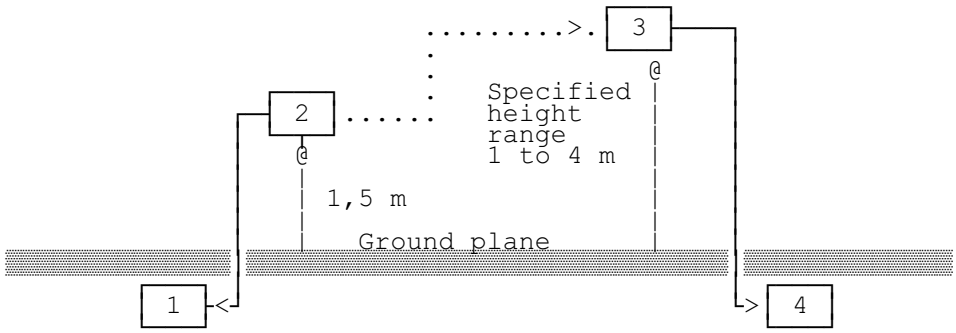
B.2.3.1 Definition

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.

B.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 B.5: 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.

Annex C (normative): Procedure for measurement of conducted spurious emissions

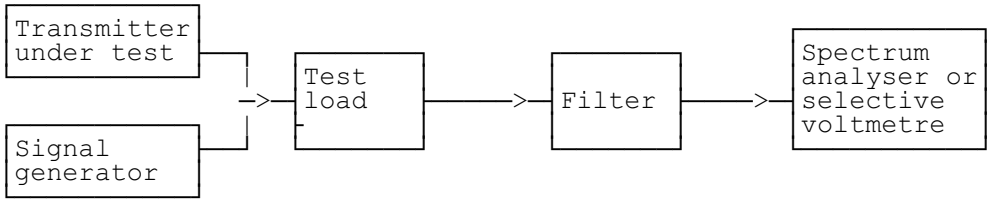
C.1 Conducted spurious emissions

C.1.1 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.

C.1.2 Method of measurement



a) The transmitter shall be connected to a spectrum analyser or a selective voltmetre through a test load and an appropriate filter to avoid overloading of the spectrum analyser or selective voltmetre. The bandwidth of the spectrum analyser or selective voltmetre 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 voltmetre 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 voltmetre 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.

History

Document history	
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