



EUROPEAN
TELECOMMUNICATION
STANDARD

ETS 300 836-1

May 1998

Source: BRAN

Reference: DE/BRAN-10-02D

ICS: 33.020

Key words: HIPERLAN, LAN, radio, testing

**Broadband Radio Acces Networks (BRAN);
High PErformance Radio Local Area Network (HIPERLAN)
Type 1;
Conformance testing specification;
Part 1: Radio type approval and Radio Frequency (RF)
conformance test specification**

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE

Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

Internet: secretariat@etsi.fr - <http://www.etsi.fr> - <http://www.etsi.org>

Tel.: +33 4 92 94 42 00 - Fax: +33 4 93 65 47 16

Copyright Notification: No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 1998. All rights reserved.

Contents

Foreword	7
1 Scope	9
2 Normative references	9
3 Definitions, symbols and abbreviations	9
3.1 Definitions	9
3.2 Symbols	11
3.3 Abbreviations	11
4 General	11
4.1 Supplier declarations	11
4.2 Presentation of equipment for type testing	12
4.2.1 Choice of model	12
4.2.2 Presentation	12
4.3 Design	12
4.3.1 General	12
4.3.2 Controls	12
4.4 Recording of measurement results	12
5 Test conditions	12
5.1 Normal and extreme test conditions	12
5.2 Power sources	13
5.3 Normal test conditions	13
5.3.1 Normal temperature and humidity	13
5.3.2 Normal power source	13
5.3.2.1 Mains voltage	13
5.3.2.2 Lead-acid battery power sources used on vehicles	13
5.3.2.3 Other power sources	13
5.4 Extreme test conditions	13
5.4.1 Extreme temperatures	13
5.4.2 Extreme power source voltages	14
5.4.2.1 Mains voltage	14
5.4.2.2 Lead-acid battery power sources used on vehicles	14
5.4.2.3 Power sources using other types of batteries	14
5.4.2.4 Other power sources	14
5.4.3 Procedure for tests at extreme temperatures	14
6 Transmitter	15
6.1 Frequency error and phase error	15
6.1.1 Definition and applicability	15
6.1.2 Conformance requirement	15
6.1.3 Test purpose	16
6.1.4 Test method	16
6.1.4.1 Initial conditions	16
6.1.4.2 Procedure	16
6.1.5 Test limits	17
6.1.5.1 Frequency error	17
6.1.5.2 Phase error	18
6.1.5.3 Frequency deviation	18
6.2 Transmit peak envelope power	18
6.2.1 Definition and applicability	18
6.2.2 Conformance requirement	18
6.2.3 Test purpose	18
6.2.4 Test method	18
6.2.4.1 Conducted measurement	18

		6.2.4.1.1	Initial conditions.....	18
		6.2.4.1.2	Procedure.....	19
	6.2.4.2		Radiated measurement.....	19
		6.2.4.2.1	Initial conditions.....	19
		6.2.4.2.2	Procedure.....	19
	6.2.5		Test limits.....	20
6.3			Output spectrum due to modulation and switching.....	20
	6.3.1		Definition and applicability.....	20
	6.3.2		Conformance requirement.....	20
	6.3.3		Test purpose.....	20
	6.3.4		Test method.....	20
		6.3.4.1	Initial conditions.....	20
		6.3.4.2	Procedure.....	21
	6.3.5		Test limits.....	22
6.4			Unwanted emissions outside the HIPERLAN bands.....	22
	6.4.1		Definition and applicability.....	22
	6.4.2		Conformance requirement.....	23
	6.4.3		Test purpose.....	23
	6.4.4		Test method.....	23
		6.4.4.1	Initial conditions.....	23
		6.4.4.2	Procedure.....	23
	6.4.5		Test limits.....	24
6.5			Defer transmission.....	24
	6.5.1		Definition and applicability.....	24
	6.5.2		Conformance requirements.....	24
	6.5.3		Test purpose.....	25
	6.5.4		Test method.....	25
		6.5.4.1	Initial conditions.....	25
		6.5.4.2	Procedure.....	25
	6.5.5		Test limits.....	25
7			Receiver.....	26
	7.1		Frame Error Ratio (FER) definition.....	26
	7.2		Sensitivity limit.....	26
		7.2.1	Conformance requirement.....	26
		7.2.2	Test purpose.....	26
		7.2.3	Test method.....	27
			7.2.3.1 Initial conditions.....	27
			7.2.3.2 Procedure.....	27
		7.2.4	Test limits.....	27
	7.3		Maximum operating input.....	27
		7.3.1	Conformance requirement.....	27
		7.3.2	Test purpose.....	27
		7.3.3	Test method.....	27
			7.3.3.1 Initial conditions.....	27
			7.3.3.2 Procedure.....	27
		7.3.4	Test limits.....	27
	7.4		Selectivity.....	28
		7.4.1	Selectivity definition.....	28
		7.4.2	Conformance requirement.....	28
		7.4.3	Test purpose.....	28
		7.4.4	Test method.....	28
			7.4.4.1 Initial conditions.....	28
			7.4.4.2 Procedure.....	28
		7.4.5	Test limits.....	28
	7.5		Receiver unwanted emissions.....	28
		7.5.1	Definition.....	28
		7.5.2	Conformance requirement.....	28
		7.5.3	Test purpose.....	29
		7.5.4	Test method.....	29
			7.5.4.1 Initial conditions.....	29
			7.5.4.2 Procedure.....	29
		7.5.5	Test limits.....	29

7.6	Long frame receiver operation.....	29
7.6.1	Conformance requirement	30
7.6.2	Test purpose	30
7.6.3	Test method	30
	7.6.3.1 Initial conditions	30
	7.6.3.2 Procedure	30
7.6.4	Test Limits.....	30
7.7	Receiver operation with frequency and data rate error.....	30
7.7.1	Conformance requirement	30
7.7.2	Test purpose	30
7.7.3	Test method	30
	7.7.3.1 Initial conditions	30
	7.7.3.2 Procedure	30
7.7.4	Test limits	30
8	Measurement uncertainty values	31
Annex A (normative): Test sites and arrangements for radiated measurements		32
A.1	Test sites.....	32
A.1.1	Open air test sites.....	32
A.1.2	Anechoic chamber	32
	A.1.1.1 General.....	33
	A.1.1.2 Description	33
	A.1.1.3 Influence of parasitic reflections	34
	A.1.1.4 Calibration and mode of use	35
A.2	Test antenna	35
A.3	Substitution antenna.....	35
Annex B (normative): General description of measurement		36
B.1	Conducted measurements	36
B.2	Radiated measurements	36
B.3	Substitution measurement	37
Annex C (normative): Description of Protocol Data Unit (PDU) sequences for test use.....		38
C.1	Transmitter testing measurement test sequence (user specified channel number)	38
C.1.1	Transmission conditions and pre-conditions.....	38
C.1.2	PDUs transmitted by the UUT, common characteristics	38
C.1.3	Transmitted PDU sequence characteristics:	38
C.1.4	Other SS Activity during sequence reception:	38
C.2	Transmission deferral test sequence	39
C.2.1	Transmission conditions and pre-conditions.....	39
C.2.2	PDUs transmitted by the UUT, common characteristics	39
C.2.3	Transmitted PDU sequence characteristics:	39
C.2.4	Other SS Activity during sequence reception:	39
C.3	Transmission deferral test sequence, (MADT)	40
C.3.1	Transmission conditions and pre-conditions:.....	40
C.3.2	PDUs transmitted by the UUT, common characteristics	40
C.3.3	Transmitted PDU sequence characteristics:	40
C.3.4	Other SS activity:	40
C.4	Transmission deferral test sequence, (MADT maximum value)	41
C.4.1	Transmission conditions and pre-conditions.....	41
C.4.2	PDUs transmitted by the UUT, common characteristics	41
C.4.3	Transmitted PDU sequence characteristics	41

C.4.4	Other SS Activity:	41
C.5	Basic receiver FER measurement test sequence, (channel 4)	42
C.5.1	Transmission conditions and pre-conditions	42
C.5.2	Transmitted PDUs common characteristics:.....	42
C.5.3	Transmitted PDU sequence characteristics:.....	42
C.5.4	Other SS activity during sequence transmission:.....	42
C.6	Long frame, receiver FER measurement test sequence.....	42
C.6.1	Transmission conditions and pre-conditions	43
C.6.2	Transmitted PDUs common characteristics.....	43
C.6.3	Transmitted PDU sequence characteristics:.....	43
C.6.4	Other SS Activity during sequence transmission:	43
C.7	Receiver FER with frequency and data rate error test sequence.....	43
C.7.1	Transmission conditions and pre-conditions.....	44
C.7.2	Transmitted PDUs common characteristics.....	44
C.7.3	Transmitted PDU sequence characteristics:.....	44
C.7.4	Other SS Activity during sequence transmission:	44
C.8	Receiver emissions and adjacent channel test sequence, (channel 3).....	44
C.8.1	Transmission conditions and pre-conditions	45
C.8.2	Transmitted PDUs common characteristics.....	45
C.8.3	Transmitted PDU sequence characteristics:.....	45
C.8.4	Other SS activity during sequence transmission:.....	45
Annex D (normative):	Subclauses of this ETS relevant for compliance with the essential requirements of relevant EC Council Directives	46
Annex E (informative):	Bibliography	47
History		48

Foreword

This European Telecommunication Standard (ETS) has been produced by the ETSI Project Broadband Radio Access Networks (BRAN) of the European Telecommunications Standards Institute (ETSI).

This ETS has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 83/189/EEC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

This ETS, together with ETS 300 826 [3], is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC as amended).

Technical specifications relevant to the EMC Directive are given in annex D.

This ETS consists of 4 parts as follows:

- Part 1: "Radio type approval and Radio Frequency (RF) conformance test specification";
- Part 2: "Protocol Implementation Conformance Statement (PICS) proforma specification";
- Part 3: "Test Suite Structure and Test Purposes (TSS&TP) specification";
- Part 4: "Abstract Test Suite (ATS) specification".

Transposition dates	
Date of adoption of this ETS:	1 May 1998
Date of latest announcement of this ETS (doa):	31 August 1998
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	28 February 1999
Date of withdrawal of any conflicting National Standard (dow):	28 February 1999

Blank page

1 Scope

This European Telecommunication Standard (ETS) specifies the radio type approval and Radio Frequency (RF) conformance testing of the High Performance Radio Local Area Network (HIPERLAN) functional specification as specified in ETS 300 652 [1].

HIPERLAN is confined to the lowest two Open Systems Interconnection (OSI) layers, namely the physical layer and the data link layer. Functions of higher layers are required for operation and interworking of a complete system and are outside the scope of HIPERLAN.

This ETS applies only to Units Under Test (UUT) operating in the band 5,15 GHz to 5,30 GHz. The use of the band 17,1 GHz to 17,3 GHz is covered by other HIPERLAN standards.

2 Normative references

This ETS incorporates by dated and 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 ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] ETS 300 652 (1996) and prA1 (1996): "Radio Equipment and Systems (RES); High Performance Radio Local Area Network (HIPERLAN); Type 1; Functional specification".
- [2] ETS 300 836-2: "Radio Equipment and Systems (RES); High Performance Radio Local Area Network (HIPERLAN) Type 1; Conformance testing specification; Part 2: Protocol Implementation Conformance Statement (PICS) proforma specification".
- [3] ETS 300 826: "Radio Equipment and Systems (RES); ElectroMagnetic Compatibility (EMC) standard for 2,4 GHz wide band transmission systems and High Performance Radio Local Area Network (HIPERLAN) equipment in the 5,2 and 17,2 GHz bands".
- [4] ETR 028: "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".
- [5] ISO/IEC 8802: "Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements".
- [6] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply, in addition to those given in ETS 300 652 [1].

all conditions: Normal and extreme conditions.

antenna diversity: A plurality of RF input ports to a HIPERLAN receiver, or output ports of a transmitter. For reception, it is implied that the set of signals from the set of ports can have low cross-correlation. For transmission, it is implied that transmitted signals from the set of ports can have low cross-correlation at a general point in space. It is also allowed that a HIPERLAN node can select different antenna properties such as gain, polarization, coverage pattern, or other feature(s) that can affect the practical coverage. A typical example is space diversity.

burst: A period during which radio waves are intentionally transmitted, preceded and succeeded by periods during which no intentional transmission is made.

combined HIPERLAN equipment: A combination of a radio equipment part and a specific type of host equipment which may be used for testing according to this ETS.

default carriers: The carriers whose centre frequencies are within the frequency band 5,15 GHz to 5,25 GHz.

defer threshold: A received signal level above which a channel is deemed to be busy for the purposes of channel access.

Effective Isotropic Radiated Peak Envelope Power (EIRPEP): The peak envelope power radiated by a UUT and its antenna at any time.

high carrier number range: Carrier 4.

Local Area Network (LAN): A group of user stations each of which can communicate with at least one other using a common transmission medium commonly managed.

low carrier number range: Carrier 0.

Medium Access Control (MAC): The sub-layer of the ISO/IEC 8802 [5] reference model between the physical layer and the Logical Link Control (LLC).

mid carrier number range: Carrier 2.

normal burst: Burst containing Low Bit Rate part (LBR-part) followed by High Bit Rate part (HBR-part) data.

Normal Transmitted Power (NTP): The transmitted power averaged from the centre of the first transmitted bit of the burst to the centre of the last bit of the burst.

packet: A transmitted burst containing modulated information. A packet may be either an LBR data burst or an LBR-HBR data burst.

physical layer: Layer 1 of the ISO/OSI reference model. The mechanism for transfer of bits between HIPERLAN nodes.

Radio Frequency (RF) carrier: The centre frequency occupied by a HIPERLAN transmission.

System Simulator (SS): Test equipment that interacts with the UUT.

useful bits: All data bits in one burst (including synchronization and training sequences). Defined for normal bursts as being from 340 ns before the centre of the first LBR-part bit to the centre of the last bit of HBR-part data. Defined for ACK bursts as being from 340 ns before the centre of the first LBR-part bit to 340 ns after the centre of the last LBR-part bit.

useful HBR-part bits: All HBR-part data bits in burst (including training sequences). Defined from the centre of the first HBR-part bit to the centre of last bit of HBR-part data.

useful LBR-part bits: All LBR-part data bits in burst (including synchronization sequence). Defined from 340 ns before the centre of the first LBR-part bit to 340 ns after the centre of the last LBR-part bit.

user manual: The end user documentation to be included with the UUT.

3.2 Symbols

For the purposes of this ETS, the following symbol applies, in addition to those given in ETS 300 652 [1]:

ppm parts per million

3.3 Abbreviations

For the purposes of this ETS, the following abbreviations apply, in addition to those given in ETS 300 652 [1]:

ADT	Adaptive Defer Threshold
AK-HCPDU	AcKnowledgement HIPERLAN CAC Protocol Data Unit
ATS	Abstract Test Suite
CW	Continuous Wave
EIRPEP	Effective Isotropic Radiated Peak Envelope Power
EMC	ElectroMagnetic Compatibility
FER	Frame Error Ratio
FS	Field Strength
HBR-part	High Bit Rate part
HID	HIPERLAN IDentifier
HIPERLAN	High PErformance Radio Local Area Network
LAN	Local Area Network
LBR-part	Low Bit Rate part
LLC	Logical Link Control
MAC	Medium Access Control
MADT	Maximum Adaptive Defer Threshold
NTP	Normal Transmitted Power
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
RF	Radio Frequency
SLN	Search List Number
SS	System Simulator
TSS&TP	Test Suite Structure and Test Purposes
Tx	Transmit, Transmitter
UUT	Unit Under Test

4 General

4.1 Supplier declarations

Where parameters, capabilities, etc., are subject to suppliers declaration and not a specific test, it shall be the suppliers responsibility to:

- supply equipment conforming to ETS 300-652 [1];
- include a completed copy of the PICS (see ETS 300 836-2 [2]) with the appropriate application form and a copy of the user manual for the HIPERLAN UUT;
- be prepared to submit upon request supporting design information, including test methods (additional to this document), circuit designs and software source code, demonstrating the implementation of the said capabilities.

The supplier shall declare the following specific characteristics of the equipment:

- a) the type of UUT, either combined or plug-in (see subclause 4.2.2);
- b) where extreme operating conditions apply to the equipment offered for testing that are more stringent than those specified in subclause 5.4, these shall be declared;

- c) where the radio equipment is capable of different transmitter power settings, the supplier shall declare the intended combination(s) of the radio equipment power settings and one or more antenna assemblies. For each combination, the gain and polarization of the antenna assembly, i.e. the transfer function between the conducted RF power and EIRPEP, shall be declared;
- d) in the case of plug-in devices, the nominal voltages of the combined radio equipment or the nominal voltages of the host equipment.

4.2 Presentation of equipment for type testing

4.2.1 Choice of model

The supplier shall offer one or more production models or equivalent preliminary models, as appropriate, for type testing.

Software fitted to production models should be substantially the same as that used during type testing.

Due to the low levels of RF signal and the wideband modulations used in this type of equipment, radiated RF power measurements are imprecise. Conducted measurements are much more precise. In combination with the declared antenna assembly gain(s) adequate assurance of the RF characteristics can be achieved. Therefore, equipment offered for testing should provide a suitable connector for conducted RF power measurements. If such a connector is not provided, radiated measurements shall be performed (see annexes A and B).

4.2.2 Presentation

Combined equipment shall be offered complete with all equipment needed for testing.

Plug-in HIPERLAN equipment is intended for use with a variety of host systems. The supplier of plug-in equipment shall supply a suitable test configuration consisting of either a host system intended for normal use or a test jig that is representative of the range of host systems in which the UUT may be used. The test jig shall allow the UUT to be powered and stimulated in a way similar to the way it would be powered and stimulated when connected to or inserted into host equipment.

4.3 Design

4.3.1 General

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

4.3.2 Controls

There shall be no controls or software accessible to the end user which, if maladjusted, might increase the radio interfering potential of the equipment. This does not apply to test harnesses and software supplied solely for the purposes of testing.

4.4 Recording of measurement results

The test results shall be recorded in the appropriate test report form.

The recorded value of the measurement uncertainty for each measurement shall be equal to or lower than the figures in table 5.

5 Test conditions

5.1 Normal and extreme test conditions

Tests shall be made under the test conditions as specified in the test purposes (see also subclause 4.1 regarding supplier declarations).

5.2 Power sources

During type tests, the normal 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 5.3.2 and 5.4.2. For the purpose of tests, the voltage of the power source shall be measured as close as possible to the input terminals of the UUT. However, the measurement uncertainty limits in table 5 shall apply.

5.3 Normal test conditions

5.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature: +15°Celsius to +35°Celsius;
- relative humidity: 20 % to 75 %.

The actual values during the tests shall be recorded in the appropriate test report form.

5.3.2 Normal power source

5.3.2.1 Mains voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage and frequency. For the purpose of this ETS, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

5.3.2.2 Lead-acid battery power sources used on vehicles

When radio equipment is intended for operation from the usual, alternator fed lead-acid battery power source used on vehicles, then the normal test voltage shall be 1,1 times the nominal voltage of the battery (6V, 12V, etc.).

5.3.2.3 Other power sources

For operation from other power sources or types of battery (primary or secondary), the nominal test voltage shall be as declared by the equipment supplier. This shall be recorded in the appropriate test report form.

5.4 Extreme test conditions

If the supplier declares test conditions more extreme than those specified in subclause 5.4.1 then the suppliers declaration shall be substituted.

5.4.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in subclause 5.4.3, at the upper and lower temperatures of the range as follows:

- temperature: - 20°Celsius to + 55°Celsius.

Where the suppliers declared operating range does not include the range of - 20°Celsius to + 55°Celsius, the equipment shall be tested over the following temperature ranges:

- a) 08°C to + 35°C for equipment intended for indoor use only, or intended for use in areas where the temperature is controlled within this range;
- b) over the extremes of the operating temperature range(s) of the declared host equipment(s) in case of plug-in radio devices.

The temperature range used in the type testing shall be recorded in the test report form and shall be stated in the user manual.

5.4.2 Extreme power source voltages

Tests at extreme power source voltages specified below are not required when the UUT is designed for operation as part of and powered by another system or piece of equipment. Where this is the case, the limit values of the host system or host equipment shall apply. The appropriate limit values shall be declared by the supplier and recorded in the test report.

5.4.2.1 Mains voltage

The extreme test voltage for equipment to be connected to an AC mains source shall be the nominal mains voltage $\pm 10\%$.

5.4.2.2 Lead-acid battery power sources used on vehicles

When radio equipment is intended for operation from the usual type of alternator fed lead-acid battery power source used on vehicles, then extreme test voltage shall be 1,3 and 0,9 times the nominal voltage of the battery (6 V, 12 V, etc.).

5.4.2.3 Power sources using other types of batteries

The lower extreme test voltages for equipment with power sources using the following types of battery, shall be:

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

In both cases, the upper extreme test voltage shall be 1,15 times the nominal voltage of the battery.

5.4.2.4 Other power sources

For equipment using other power sources, or capable of being operated from a variety of power sources (primary or secondary), the extreme test voltages shall be those declared by the supplier; these shall be recorded in the test report.

5.4.3 Procedure for tests at extreme temperatures

Before measurements are made the equipment shall have reached thermal balance in the test chamber.

The equipment shall be switched off during the temperature stabilizing period. In the case of equipment containing temperature stabilizing circuits designed to operate continuously, these circuits shall be switched on for 15 minutes after thermal balance has been reached. After this time the equipment shall meet the specified requirements. For this type of equipment the supplier shall provide for the power source circuit feeding these circuits to be independent of the power source of the rest of the equipment.

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

Before tests at the upper extreme temperature, the equipment shall be placed in the test chamber and left until thermal balance is attained.

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

6 Transmitter

In this clause on transmitter measurements, the procedures to test equipment which is fitted with a permanent antenna connector and the procedures to test equipment which is designed to only be used with an integral antenna are in general combined into one single test description.

For HIPERLANs fitted with an integral antenna and having no means of connecting an external antenna, tests are specified in terms of received field strength. The power levels in ETS 300 652 [1] assume an isotropic antenna and can be readily converted to field strength.

EXAMPLE 1: Refer to ETS 300 652 [1], table 43, subclause 9.9.3.1. At the sensitivity limit, an incident field strength of 119 mV/m is implied for class A receiver equipment, (and relevant for receiver equipment of classes B and C).

Thus, whatever the antenna gain value declared by the supplier, the limiting sensitivity is always defined in terms of field strength. The equivalent Field Strength (FS) can be calculated in V/m as follows:

$$FS = \left(\frac{F}{c} \right) \sqrt{\frac{377 \times 4\pi \times P}{G}}$$

Where F is the frequency corresponding to the channel in use, c is the speed of light, 377 A is the impedance of free space, P is the power specified in ETS 300 652 [1] and G is the gain of the antenna (= 1,0 (0 dBi) for an isotropic antenna).

For UUTs fitted with a permanent antenna connector, conducted measurements shall be made. For all tests identified in annex C as intended for type approval, the nominal antenna gain declared by the supplier in the PICS (ETS 300 836-2 [2]) shall be used. For all other tests, the power levels applied to the receiver input may be computed based on the nominal antenna gain declared by the supplier in the PICS, or based on the precise gain of the supplied antenna.

EXAMPLE 2: If a -5 dBi antenna is declared the equivalent level applied to the receiver input will be increased by 5 dB.

6.1 Frequency error and phase error

6.1.1 Definition and applicability

The frequency error is the difference in frequency, after adjustment for the effect of the modulation and phase error, between the RF transmission from the UUT and the nominal frequency for the carrier number used.

The phase error is the difference in phase, after adjustment for the effect of the frequency error, between the RF transmission from the UUT and the theoretical transmission according to the intended modulation.

6.1.2 Conformance requirement

The following conformance requirements apply:

- a) the UUT carrier frequency shall be accurate to within 10 ppm;
- b) the rms phase error (difference between the phase error trajectory and its linear regression on the HBR-part data) for each burst shall not be greater than 10 degrees over any 1 000 bits;
- c) the maximum peak phase deviation during the useful part of each HBR-part data shall not be greater than 30 degrees;
- d) the frequency deviation during the LBR-part data shall not exceed limits in ETS 300 652 [1], subclause 9.7.4.2, table 33 for LBR-part data not followed by HBR-part data and table 34 for LBR-part data followed by HBR-part data.

6.1.3 Test purpose

The following test purposes apply:

- a) to verify that the UUT carrier frequency error does not exceed 10 ppm:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations);
- b) to verify that the rms unit phase error on the HBR-part useful part of the bursts transmitted by the UUT does not exceed conformance requirement b) (subclause 6.1.2):
 - 1) under normal conditions;
- c) to verify that the maximum phase error on the useful part of the bursts transmitted by the UUT does not exceed conformance requirement c) (subclause 6.1.2):
 - 1) under normal conditions;
- d) to verify that the maximum frequency error during LBR-part data transmitted by the UUT does not exceed conformance requirement d) (subclause 6.1.2):
 - 1) under normal conditions.

6.1.4 Test method

In order to measure the accuracy of the frequency and phase error a sampled measurement of the transmitted phase trajectory is obtained. This is compared with the theoretically expected phase trajectory. The regression line of the difference between the expected trajectory and the measured trajectory is an indication of the frequency error (assumed constant through the burst), whilst the departure of the phase differences from this trajectory is a measure of the phase error. The peak phase error is the value furthest from the regression line and the rms phase error is the root mean square of the phase error of all samples.

The formulae presented below are for general guidance only. For example, they do not take account of the modulo arithmetic implicit to phase measurement and the static phase shifts between the measured and sampled phase data arrays.

6.1.4.1 Initial conditions

The UUT and SS shall be operated according to test sequence TS_T1 (defined in annex C) with channel number 0.

The UUT shall be configured to its maximum power control level. Conducted measurements shall be repeated under normal and extreme test conditions. A radiated measurement shall be constrained to normal conditions due to the constraints of the measurement technique (but see subclause 4.1 regarding supplier declarations).

6.1.4.2 Procedure

The following procedure shall be followed:

- a) for one transmitted burst, the SS shall capture the signal as a series of phase samples over the period of the burst. These samples are evenly distributed over the duration of the burst with a minimum sampling rate of $2/T$, where T is the modulation symbol period;
- b) the SS shall calculate, from the known bit pattern and the formal definition of the modulator contained in ETS 300 652 [1] subclause 9.7.1, the expected phase trajectory;

c) from a) and b) the phase trajectory error shall be calculated, and a linear regression line computed through this phase trajectory error. The slope of this regression line is the frequency error of the HIPERLAN transmitter relative to the simulator reference. The difference between the regression line and the individual sample points is the phase error of that point;

1) the sampled array of phase measurements is represented by the vector:

$$-m = -m(0) \dots -m(n)$$

2) the calculated array, at the corresponding sampling instants, is represented by the vector:

$$-c = -c(0) \dots -c(n)$$

3) the error array is represented by the vector:

$$-e = \{-m(0) - -c(0)\} \dots \{-m(n) - -c(n)\} = -e(0) \dots -e(n)$$

4) the corresponding sample numbers form a vector $t = t(0) \dots t(n)$ where $t(n) = n \cdot \gamma$ and γ is the sampling interval;

5) by regression theory the slope of the samples with respect to t is k where:

$$k = \frac{\sum_{j=0}^{j=n} t(j) \cdot -e(j)}{\sum_{j=0}^{j=n} t(j)^2}$$

6) the frequency error is given by $k/360$ where all phase samples are measured in degrees;

7) the individual phase errors from the regression line are given by:

$$-e(j) - k \cdot t(j)$$

8) the rms unit value $-E$ of the phase errors is given by:

$$-E(\text{rms unit}) = \left[\frac{\sum_{j=0}^{j=n} \{-e(j) - k \cdot t(j)\}^2}{n + 1} \right]^{1/2}$$

9) during the transmission of LBR-part data the frequency of the transmission shall be measured as a function of time to a time resolution at least equal to that used for the HBR-part data.

6.1.5 Test limits

6.1.5.1 Frequency error

For all measured bursts, the frequency error, derived in step c.6), subclause 6.1.4.2, shall be less than 10 ppm.

6.1.5.2 Phase error

For all measured bursts, the rms unit phase error during HBR-part data, derived in step c.8), subclause 6.1.4.2, shall not exceed 10 degrees.

For all measured bursts, each individual phase error during HBR-part data, derived in step c.7), subclause 6.1.4.2, shall not exceed 30 degrees.

6.1.5.3 Frequency deviation

For all measured bursts the frequency with time profile of the LBR-part data shall meet the requirements of ETS 300 652 [1] subclause 9.7.4.2, tables 33 and 34 and the time mask in figure 39 of ETS 300 652 [1].

6.2 Transmit peak envelope power

6.2.1 Definition and applicability

The transmitter peak envelope power is the power delivered to an artificial antenna or radiated by the UUT and its integral antenna, over the time that the useful bits of one burst are transmitted.

6.2.2 Conformance requirement

The following conformance requirements apply:

- a) the UUT EIRPEP shall not exceed 1W (defined in ETS 300 652 [1], subclause 9.8.1.1):
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations);
- b) the power control levels shall have the nominal output power levels as defined in ETS 300 652 [1], subclause 9.8.1.6 from the lowest power control level up to the maximum output power corresponding to the class of the UUT:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

6.2.3 Test purpose

The following test purposes apply:

- a) to verify that the maximum output power of the UUT, under all conditions, is within conformance requirement a) of subclause 6.2.2;
- b) to verify that the power control levels of the UUT, under normal conditions, is within conformance requirement b) of subclause 6.2.2.

6.2.4 Test method

Different methods of test are described for radiated (see annex C) or conducted tests.

6.2.4.1 Conducted measurement

6.2.4.1.1 Initial conditions

The UUT and SS shall be operated according to test sequence TS_T1 (defined in annex C) with channel 0.

6.2.4.1.2 Procedure

The following procedure shall apply:

- a) measurement of transmitter output power:
 - the SS shall take power measurement samples evenly distributed over the duration of one burst with a sampling rate of at least $2/T$, where T is the HBR-part bit duration. The samples shall be identified in time with respect to the modulation on the burst. The SS shall identify the end of the training sequence, i.e. the transition from HBR-part bit 449 to HBR-part bit 450 as the timing reference;
 - the SS shall also take power measurements samples during LBR-part data. Samples should be evenly distributed over the duration of one burst with a sampling rate of at least $2/T$, where T is the HBR-part bit duration. The samples shall be identified in time with respect to the modulation on the burst. The SS shall identify the end of the synchronization sequence, i.e. the transition from LBR-part bit 9 to LBR-part bit 10, as the timing reference;
 - the transmitter output power shall be calculated as the average of the samples over the useful bits. This is also used as the 0 dB reference for the power/time template;
 - the transmitter peak output power is the maximum power recorded in any sample during the test.
- b) measurement of normal burst power/time relationship (see figures 39 and 40, subclauses 9.7.4.2 and 9.8.1.2 of ETS 300-652 [1]):
 - the array of power samples measured in a) shall be referenced in time to the end of the training/synchronization sequences and in power to the 0 dB reference, as identified in a);
- c) steps a) and b) shall be repeated with the UUT configured to operate on all power levels 0, 1 and 2 (as defined in ETS 300-652 [1], subclause 9.8.1.6), where applicable to the transmitter class of the UUT;
- d) step a) shall be repeated for channels 1, 2, 3 and 4;
- e) steps a) and b) shall be carried out under extreme test conditions.

6.2.4.2 Radiated measurement

For general information regarding radiated measurements, see annexes A and B.

6.2.4.2.1 Initial conditions

The UUT and SS shall be operated according to test sequence TS_T1 (defined in annex C) with channel 0.

The UUT shall be configured to its maximum power control level.

6.2.4.2.2 Procedure

The following procedure shall apply:

- a) the test procedure in subclause 6.2.4.1.2 shall be followed excluding step e). In step a), measurements shall be made where the UUT is rotated until the maximum EIRPEP is recorded.

The measurements taken are relative transmitter output power measurements. The EIRPEP values can be derived as follows.

- b) EIRPEP calibration procedure is as follows:
 - the UUT shall be replaced by a substitution antenna, of known gain with respect to isotropic (G) at channels 0, 1, 2, 3 and 4, connected to an RF generator;

- the frequency of the RF signal generator shall be set to the channel number used for the measurements in step a), the output power shall be adjusted to reproduce the peak relative transmitter output powers recorded in step a);
 - the EIRPEP values shall be derived from the power fed to the substitution antenna and its gain calibration factor;
- c) steps a) and b) shall be repeated with the UUT configured to operate on all power levels 0, 1 and 2 (as defined in ETS 300-652 [1], subclause 9.8.1.6), where applicable to the transmitter class of the UUT;
- d) steps a) and b) shall be repeated under extreme voltage test conditions;
- e) steps a) and b) shall be repeated with the UUT configured to operate on all power levels 0, 1 and 2 (as defined in ETS 300-652 [1], subclause 9.8.1.6), even if the supplier declaration states they are not supported by the UUT.

6.2.5 Test limits

The following limits shall apply:

- a) the transmitter EIRPEP, under every combination of normal and extreme test conditions, for all bursts and at each frequency shall never exceed 1W (+30dBm);
- b) the transmitter power control levels for all bursts, at each frequency and for each power control level applicable to the UUT power class, shall be at the relevant level shown in tables 35, 36 and 37 in ETS 300 652 [1], subclause 9.8.1.6.

6.3 Output spectrum due to modulation and switching

6.3.1 Definition and applicability

The output spectrum due to modulation and switching is the relationship between the frequency offset from the nominal carrier and the power, measured in a specified bandwidth and time, produced by the UUT due to the effects of modulation and power ramping.

6.3.2 Conformance requirement

The following conformance requirement shall apply:

- a) the level of the output spectrum due to modulation and switching transients for all bursts shall be no more than that given in table 1 (taken from ETS 300 652 [1], subclause 9.8.2.2, table 40).

6.3.3 Test purpose

The following test purposes shall apply:

- a) to verify that the output RF spectrum due to modulation does not exceed the level specified in conformance requirement a), subclause 6.3.2:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

6.3.4 Test method

6.3.4.1 Initial conditions

The UUT and SS shall be operated according to test sequence TS_T1 (defined in annex C) with channel number 0.

6.3.4.2 Procedure

6.3.4.2.1 Determination of the reference average power levels for each channel

The following procedure shall apply:

a) the settings of the spectrum analyser shall be as follows:

- zero frequency scan;
- resolution bandwidth: 1 MHz;
- video bandwidth: 1 MHz;
- video averaging: on.

The video signal of the spectrum analyser shall be "gated" such that the spectrum shall be measured between 1,5 μ s after the start of the burst to 1,5 μ s before the end of the burst.

NOTE: The start and the end of the burst are defined in ETS 300 652 [1] subclause 9.8.1.2.

This gating may be analogue or numerical, dependent upon the design of the spectrum analyser.

- b) by tuning the spectrum analyser centre frequency to the channel centre frequency $F(c)$ as shown in table 29, ETS 300 652 [1] subclause 9.2.1, the average power in 1 MHz centred on $F(c)$ shall be measured over at least 50 maximum length and 50 minimum length bursts, plus associated contention resolution cycles and LBR-part data burst transmissions. The average power in 1 MHz centred on $F(c)$ is the reference level for relative power measurements on each channel and shall be recorded for use to compute relative power levels as described below;
- c) steps a) and b) shall be repeated with the HIPERLAN UUT configured to transmit on channels 1, 2, 3 and 4.

6.3.4.2.2 Determination of the relative peak power levels for modulation and spurious emissions during switching

The following procedure shall apply:

a) the settings of the spectrum analyser shall be as follows:

- Zero frequency scan;
- Resolution bandwidth: 1 MHz;
- Video bandwidth: 1 MHz;
- Video mode: Positive Peak Detector, Maximum Hold.

b) the spectrum analyser centre frequency (F) shall be tuned to measurement frequencies at every 1 MHz interval in the frequency offset ranges where peak power levels are defined in ETS 300 652 [1], table 40. For each frequency offset range where peak power levels are defined, the maximum value of peak power relative to the reference average power level for the channel number in use shall be noted.

The duration of each peak power measurement (at each measurement frequency) shall be such as to cover 50 maximum length and 50 minimum length bursts, plus associated contention resolution cycles and LBR-part data burst transmissions. Measurements shall be taken between 1,5 μ s before the start of the burst to 3 μ s after the end of the burst.

- c) steps a) and b) shall be repeated with the UUT configured to transmit on all the other channels, 1, 2, 3 and 4;
- d) steps a), b) and c) shall be repeated with the UUT configured to transmit on the minimum power level for the class of UUT;
- e) steps a), b) and c) shall be repeated under extreme test conditions (see subclause 4.1 regarding supplier declarations).

6.3.4.2.3 Determination of the relative average power levels for modulation and spurious emissions during switching

The following procedure shall apply:

- a) the settings of the spectrum analyser shall be as follows:
 - Zero frequency scan;
 - Resolution bandwidth: 1 MHz;
 - Video bandwidth: 1 MHz;
 - Video averaging: on;
- b) the spectrum analyser centre frequency (F) shall be tuned to measurement frequencies at every 1 MHz interval in the frequency offset ranges where average power levels are defined in ETS 300 652 [1], table 40. For each frequency offset range where average power levels are defined, the maximum value of average power relative to the reference average power level for the channel number in use shall be noted;

The duration of each peak power measurement (at each measurement frequency) shall be such as to cover 50 maximum length and 50 minimum length bursts, plus associated contention resolution cycles and LBR-part data burst transmissions. Measurements shall be taken between 1,5 µs before the start of the burst to 1,5 µs after the end of the burst.

- c) steps a) and b) shall be repeated with the UUT configured to transmit on all the other channels, 1, 2, 3 and 4;
- d) steps a), b) and c) shall be repeated with the UUT configured to transmit on the minimum power control level for the class of UUT;
- e) steps a) to d) shall be repeated under extreme test conditions (see subclause 4.1 regarding supplier declarations).

6.3.5 Test limits

The values of relative peak and average power measured as described above, shall not exceed those limits specified in table 1 (taken from ETS 300 652 [1], table 40).

Table 1: Limits for emissions due to modulation and switching

Frequency range	Peak power in 1 MHz relative to transmitter power	Average power in 1 MHz relative to total transmitted power
$ F(c) - F < 10 \text{ MHz}$		0 dB
$10 \text{ MHz} < F(c) - F < 12 \text{ MHz}$		-5 dB
$12 \text{ MHz} < F(c) - F < 15 \text{ MHz}$		-10 dB
$15 \text{ MHz} < F(c) - F < 25 \text{ MHz}$	-12 dB	-22 dB
$25 \text{ MHz} < F(c) - F < 35 \text{ MHz}$	-30 dB	
$35 \text{ MHz} < F(c) - F < 45 \text{ MHz}$	-40 dB	
$45 \text{ MHz} < F(c) - F $	-50 dB	

There shall be no limit more stringent than -33 dBm measured in 1 MHz.

NOTE: This is particularly important for measurements at low power levels.

6.4 Unwanted emissions outside the HIPERLAN bands

6.4.1 Definition and applicability

Unwanted emissions are any emissions from a HIPERLAN transmitter outside the HIPERLAN frequency band as defined in ETS 300-652 [1], subclause 9.2.1.

6.4.2 Conformance requirement

The following conformance requirement shall apply:

- a) the level of unwanted emissions outside the HIPERLAN band for all bursts shall be no more than that given in tables 2 and 3 (taken from ETS 300 652 [1], subclause 9.8.2.1, table 38).

6.4.3 Test purpose

The following test purpose applies:

- a) to verify that the output RF spectrum due to modulation does not exceed the level specified in conformance requirement a), subclause 6.4.2:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

6.4.4 Test method

6.4.4.1 Initial conditions

The UUT and SS shall be operated according to test sequence TS_T1 (defined in annex C) with channel number 0. The UUT shall be configured to its maximum power control level.

6.4.4.2 Procedure

The following procedure shall apply:

- a) the settings of the spectrum analyser shall be as follows:
 - Zero frequency scan;
 - Resolution bandwidth: 1 MHz or 100 kHz (see ETS 300-652 [1], subclause 9.8.2.1);
 - Video bandwidth: 1 MHz;
 - Video averaging: on;

The video signal of the spectrum analyser shall be "gated" such that the spectrum measured shall be measured between 1,5 μ s before the start of the burst to 3 μ s after the end of the burst

NOTE: The start and the end of the burst are defined in ETS 300 652 [1], subclause 9.8.1.2.

This gating may be analogue or numerical, dependent upon the design of the spectrum analyser.

- b) initially the power level shall be measured over at least 50 maximum length and 50 minimum length bursts, plus associated contention resolution cycles and LBR-part data burst transmissions at all multiples of 1 MHz offset from F(c) in the ranges 5,0 GHz to 5,15 GHz and 5,25 to 5,45 GHz with a resolution bandwidth of 1 MHz;
- c) if any measurement in b) is greater than -33dBm then measurements shall be taken with a resolution bandwidth of 100 kHz at the 11 frequencies spaced 100 kHz apart in a band $\pm 0,5$ MHz centred on the failing frequency;

EXAMPLE 1: A UUT fails at 5 015 MHz. Measurements are made in a 100 kHz bandwidth on 5 014,5 MHz, 5 014,6 MHz, 5 014,7 MHz. etc. up to 5 015,5 MHz.

- d) the power level shall be measured over at least 50 maximum length and 50 minimum length bursts, plus associated contention resolution cycles and LBR-part data burst transmissions at all multiples of 1 MHz offset from F(c) in the ranges 1 GHz to 5,0 GHz and 5,45 to 26,5 GHz with a resolution bandwidth of 1 MHz;

- e) the power level shall be measured over at least 50 maximum length and 50 minimum length bursts, plus associated contention resolution cycles and LBR-part data burst transmissions at all multiples of 1 MHz offset from F(c) in the range 30 MHz to 1 GHz with a resolution bandwidth of 1 MHz initially;
- f) if any measurement in e) is greater than -36 dBm then measurements shall be taken with a resolution bandwidth of 100 kHz at the 11 frequencies spaced 100 kHz apart in a band $\pm 0,5$ MHz centred on the failing frequency;

EXAMPLE 2: A UUT fails at 505 MHz. Measurements are made in a 100 kHz bandwidth on 504,5 MHz, 504,6 MHz, 504,7 MHz. etc. up to 505,5 MHz.

- g) steps b), c), d), e) and f) shall be repeated with the UUT configured to carrier 2;
- h) steps b), c), d), e) and f) shall be repeated with the UUT configured to carrier 4;
- k) if tests are carried out using conducted measurements steps a) to h) shall be repeated under extreme test conditions (see subclause 4.1 regarding supplier declarations).

6.4.5 Test limits

The unwanted emissions of the transmitter shall not exceed the values in table 2 (taken from ETS 300-652 [1], table 38, subclause 9.8.2.1) in the indicated bands.

Table 2: Transmitter unwanted radiated emission limits

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 5 GHz	-30 dBm	1 MHz
5 GHz to 5,15 GHz	-33 dBm	100 kHz
5,30 to 5,45 GHz	-33 dBm	100 kHz
5,45 to 26,5 GHz	-30 dBm	1 MHz

When operating on channels 0,1 or 2 the limit in table 3 (taken from ETS 300-652 [1], table 39, subclause 9.8.2.1) shall also be met.

Table 3: Additional limit

Frequency range	Maximum power	Bandwidth
5,25 to 5,30 GHz	-33 dBm	100 kHz

The limits shown in ETS 300-652 [1], tables 38 and 39, subclause 9.8.2.1 apply.

6.5 Defer transmission

6.5.1 Definition and applicability

The UUT shall defer transmission during periods when the channel is busy.

6.5.2 Conformance requirements

The following conformance requirements apply:

- a) if the optional Adaptive Defer Threshold (ADT) feature is not implemented as stated by the equipment supplier in the completed PICS (ETS 300 836-2 [2]), the UUT shall not transmit if the received Search List Number (SLN) is greater than SLN1 according to ETS 300 652 [1] subclause 9.4;
- b) if the optional ADT feature is implemented as stated by the equipment supplier in the completed PICS (ETS 300 836-2 [2]), the UUT shall not transmit if:

- 1) the received SLN is greater than the Maximum Adaptive Defer Threshold (MADT), (as defined in ETS 300 652 [1] subclauses 9.4.1 9.4.2 and 9.4.3); or
- 2) the received SLN is greater than SLN 22, (as defined in ETS 300 652 [1] subclauses 9.4.1, 9.4.2 and 9.4.3).

6.5.3 Test purpose

The following test purposes apply:

- a) to verify that the UUT does not transmit when it measures an SLN greater than SLN 1 where the ADT scheme is not implemented:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations);
- b) to verify that the UUT does not transmit when it measures an SLN greater than the MADT where the ADT scheme is implemented:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations);
- c) to verify that the UUT does not transmit when it measures an SLN greater than SLN 22 where the ADT scheme is implemented:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

6.5.4 Test method

6.5.4.1 Initial conditions

The following initial conditions apply:

- a) the UUT and SS shall be operated according to test sequence TS_T2 (defined in annex C). The UUT shall be configured to its maximum power control level;
- b) the UUT and SS shall be operated according to test sequence TS_T3 (defined in annex C) The UUT shall be configured to its maximum power control level;
- c) the UUT and SS shall be operated according to test sequence TS_T4 (defined in annex C) The UUT shall be configured to its maximum power control level.

6.5.4.2 Procedure

The test procedures are defined in the different test sequences (see annex C).

6.5.5 Test limits

The following limits apply:

- a) when testing defer transmission where the optional ADT is not implemented, following the conditions specified in the appropriate test sequence, the UUT shall not transmit;
- b) when testing the effectiveness of an ADT, where implemented, following the conditions specified in the appropriate test sequence, the UUT shall transmit only when the measured signal strength is less than or equal to SLN 12;
- c) verifying the maximum MADT where ADT is implemented. Following the conditions specified in the appropriate test sequence, the UUT shall not transmit.

7 Receiver

In this clause on receiver measurements, the procedures to test equipment which is fitted with a permanent antenna connector, and the procedures to test equipment which is designed to only be used with an integral antenna, are in general combined into one single test description.

For HIPERLANs fitted with an integral antenna and having no means of connecting an external antenna, tests are specified in terms of received field strength. The power levels in ETS 300 652 [1] assume an isotropic antenna and can be readily converted to field strength.

EXAMPLE 1: Refer to ETS 300 652 [1], table 43, subclause 9.9.3.1. At the sensitivity limit, an incident field strength of 119 mV/m is implied for class A receiver equipment, (and pro-rata for receiver equipment of classes B and C).

Thus, whatever the antenna gain value declared by the supplier, the limiting sensitivity is always defined in terms of field strength. The equivalent Field Strength (FS) in V/m can be calculated as follows:

$$FS = \left(\frac{F}{c} \right) \sqrt{\frac{377 \times 4\pi \times P}{G}}$$

Where F is the frequency corresponding to the channel in use, c is the speed of light, 377 A is the impedance of free space, P is the power specified in ETS 300 652 [1] and G is the gain of the antenna (= 1,0 (0 dBi) for an isotropic antenna).

For UUT fitted with a permanent antenna connector conducted measurements shall be made. For all tests identified in annex C as intended for type approval the nominal antenna gain declared by the supplier in the PICS (ETS 300 836-2 [2]) shall be used. The power levels applied to the receiver input may be computed based on the nominal antenna gain declared by the supplier in the PICS, or based on the precise gain of the supplied antenna.

EXAMPLE 2: If a -5dBi antenna is declared the equivalent level applied to the receiver input will be increased by 5 dB.

7.1 Frame Error Ratio (FER) definition

For the purposes of testing, a frame error is indicated by the non-return of an Acknowledgement HIPERLAN CAC Protocol Data Unit (AK-HCPDU) for the defined test sequences. Non-return of an AK-HCPDU means either no AK-HCPDU was returned or an incorrect AK-HCPDU was returned.

The FER is defined as the proportion of non-returned AK-HCPDUs.

7.2 Sensitivity limit

7.2.1 Conformance requirement

The following conformance requirements apply:

- a) the frame error ratio shall be less than the maximum value specified in ETS 300 652 [1], subclause 9.9.3;
- b) the frame error ratio shall be less than the maximum value specified in ETS 300 652 [1] subclause 9.9.3 after the application of an input signal level of 0 dBm as specified in ETS 300 652 [1] subclause 9.9.3.3.

7.2.2 Test purpose

The following test purposes apply:

- a) to verify that the frame error ratio falls within the limit specified in conformance requirements a) and b) in subclause 7.2.1:

- 1) under normal conditions;
- 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

7.2.3 Test method

7.2.3.1 Initial conditions

An in-band Continuous Wave (CW) signal of power equivalent to 0 dBm shall be applied at the receiver input for not less than 30 seconds.

Test sequence TS_R1 (see annex C) shall be applied to the receiver input at the reference sensitivity power level (see ETS 300 652 [1] subclause 9.9.3.1, table 43) according to the receiver class declaration in the PICS (ETS 300 836-2 [2]).

7.2.3.2 Procedure

The frame error ratio shall be computed from the proportion of non-returned AK-HCPDUs.

These measurements shall be repeated at extreme conditions (see subclause 4.1 regarding supplier declarations).

7.2.4 Test limits

The FER shall be less than the limit specified in ETS 300 652 [1] subclause 9.9.3.

7.3 Maximum operating input

7.3.1 Conformance requirement

The following conformance requirement applies:

- a) the frame error ratio shall be less than the maximum value specified in ETS 300 652 [1] subclause 9.9.3.2.

7.3.2 Test purpose

The following test purpose applies:

- a) to verify that the frame error ratio falls within the limit specified in conformance requirement a) in subclause 7.3.1:
 - 1) under normal conditions.

7.3.3 Test method

7.3.3.1 Initial conditions

Test sequence TS_R1 (see annex C) shall be applied to the receiver input at the maximum input level for operation (see ETS 300 652 [1] subclause 9.9.3.2).

7.3.3.2 Procedure

The frame error ratio shall be computed from the proportion of non-returned AK-HCPDUs.

7.3.4 Test limits

The FER shall be less than the limit specified in ETS 300 652 [1], subclause 9.9.3.2.

7.4 Selectivity

7.4.1 Selectivity definition

The selectivity is the ability of a HIPERLAN to function on a wanted channel whilst an adjacent radio channel is busy.

7.4.2 Conformance requirement

The following conformance requirement applies:

- a) the frame error ratio shall be less than the maximum value specified in ETS 300 652 [1] subclause 9.9.3.4.

7.4.3 Test purpose

- a) to verify that the frame error ratio falls within the limit specified in conformance requirement a) in subclause 7.4.2 during adjacent channel activity:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

7.4.4 Test method

7.4.4.1 Initial conditions

Test sequence TS_R1, see annex C, shall be applied as the wanted signal to the receiver input at 3 dB above the reference sensitivity power level (see ETS 300 652 [1] subclause 9.9.3.1, table 43) according to the receiver class declaration in the PICS (ETS 300 836-2 [2]).

Test sequence TS_R4, see annex C, shall be applied as the adjacent channel signal to the receiver input at 3 dB above the reference sensitivity power level (see ETS 300 652 [1] subclause 9.9.3.1, table 43) according to the receiver class declaration in the PICS (ETS 300 836-2 [2]).

7.4.4.2 Procedure

The frame error ratio shall be computed from the proportion of non-returned AK-HCPDUs.

These measurements shall be computed at extreme conditions (see subclause 4.1 regarding supplier declarations).

7.4.5 Test limits

The FER shall be less than the limit specified in ETS 300 652 [1] subclause 9.9.3.4.

7.5 Receiver unwanted emissions

7.5.1 Definition

Receiver spurious emissions include UUT spurious emissions at all times other than during burst transmission.

7.5.2 Conformance requirement

The following conformance requirement applies:

- a) the receiver spurious emissions shall be less than the maximum values specified in table 4 (taken from ETS 300 652 [1] subclause 9.9.1, table 41).

7.5.3 Test purpose

The following test purpose applies:

- a) to verify that receiver spurious emissions fall within the limits specified in conformance requirement a) in subclause 7.5.2:
 - 1) under normal conditions;
 - 2) under extreme conditions (see subclause 4.1 regarding supplier declarations).

7.5.4 Test method

7.5.4.1 Initial conditions

Test sequence TS_R4, see annex C, shall be applied to the receiver input at the reference sensitivity level appropriate to the receiver class as declared in the PICS (ETS 300 836-2 [2]), (see ETS 300 652 [1] subclause 9.9.3.1).

7.5.4.2 Procedure

Using a directional coupler, circulator or gating to remove the transmissions made by the SS (and/or other means to isolate the emissions measurements instrument from the signals transmitted by the SS) the radio emissions from the UUT shall be measured while the UUT receives multicast transmissions from the SS.

- a) the settings of the spectrum analyser shall be as follows:
 - zero frequency scan;
 - resolution bandwidth: 1 MHz or 100 kHz (see table 41, subclause 9.9.1 of ETS 300 652 [1]);
 - video bandwidth: 1 MHz;
 - video averaging: on;
- b) tuning the spectrum analyser centre frequency F over the measurement frequency bands specified in table 41, ETS 300 652 [1] subclause 9.9.1, the power level of UUT receiver emissions shall be measured during continuous SS transmissions. If gating is used to remove the unwanted energy from SS transmissions, the tuning of the spectrum analyser shall not change during the gated-out time interval;
- c) steps a) and b) shall be repeated under extreme test conditions (see subclause 4.1 regarding supplier declarations).

7.5.5 Test limits

The receiver spurious emissions from the UUT shall be less than the limits given in table 4 (taken from subclause 9.9.1, table 41 of ETS 300 652 [1]).

Table 4: Spurious radiated emission limits

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 26,5 GHz	-47 dBm	1 MHz

7.6 Long frame receiver operation

The MAC protocol part of ETS 300 652 [1] specifies a maximum amount of user data that can be transferred in a single burst. This test is included so that compliance to this part of ETS 300 652 [1] can be verified.

7.6.1 Conformance requirement

The following conformance requirement applies:

- a) the frame error ratio shall be less than the maximum value specified in ETS 300 652 [1], subclause 9.9.3 when the receiver is operating with the longest possible burst lengths, see ETS 300 652 [1] subclause 6.7.3.11.

7.6.2 Test purpose

The following test purpose applies:

- a) to verify that the receiver functions adequately when the burst length is at maximum:
 - 1) under normal conditions.

7.6.3 Test method

7.6.3.1 Initial conditions

Test sequence TS_R2 (see annex C) shall be applied to the receiver input at a power level of -30 dBm.

7.6.3.2 Procedure

The frame error ratio shall be computed from the proportion of non-returned AK-HCPDUs.

7.6.4 Test Limits

The FER shall be less than the limit specified in ETS 300 652 [1] subclause 9.9.3.

7.7 Receiver operation with frequency and data rate error

7.7.1 Conformance requirement

The following conformance requirement applies:

- a) the frame error ratio shall be less than the maximum value specified in ETS 300 652 [1], subclause 9.9.3 when the receiver is operating with bursts having frequency and data rate errors that vary within the limits specified in ETS 300 652 [1] subclauses 9.2.2 and 9.7.3.1.

7.7.2 Test purpose

The following test purpose applies:

- a) to verify that the receiver functions adequately according to the conformance requirement:
 - 1) under normal conditions.

7.7.3 Test method

7.7.3.1 Initial conditions

Test sequence TS_R3 (see annex C) shall be applied to the receiver input at a power level of -30dBm.

7.7.3.2 Procedure

The frame error ratio shall be computed from the proportion of non-returned AK-HCPDUs.

7.7.4 Test limits

The FER shall be less than the limit specified in ETS 300 652 [1] subclause 9.9.3.

8 Measurement uncertainty values

The maximum values of measurement uncertainties of the measurements defined in this ETS shall not exceed the values in table 5.

Table 5: Measurement uncertainty values

Parameter	Uncertainty
Radio frequency	+/- 0,5 ppm
Total RF power, conducted	+/- 1,5 dB
RF power density, conducted	+/- 3 dB
Spurious emissions, conducted	+/- 3 dB
All emissions, radiated	+/- 6 dB
Temperature	+/- 1°C
Humidity	+/- 5 %
DC and low frequency voltages	+/- 3 %

For the measurement methods according to this ETS these uncertainty figures are valid to a confidence level of 95 % calculated according to the methods described in ETR 028 [4].

Annex A (normative): Test sites and arrangements for radiated measurements

A.1 Test sites

A.1.1 Open air test sites

The term "open air" should 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.

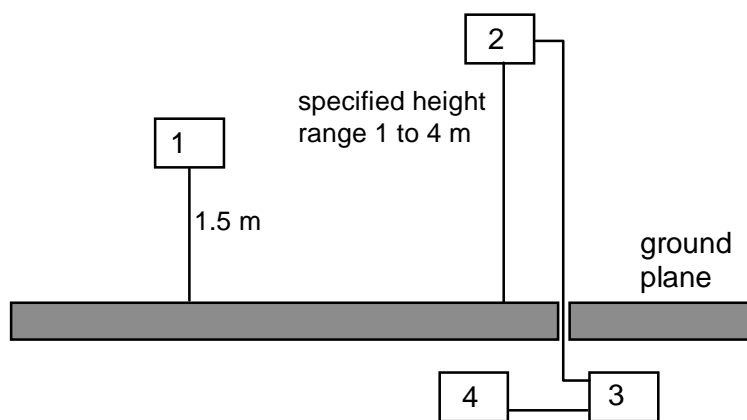
An open air test site may be used to perform the measurements using the radiated measurement methods described in clause 7. Absolute or relative measurements may be performed on transmitters or on receivers; absolute measurements of field strength require a calibration of the test site.

For measurements at frequencies below 1 GHz, a measurement distance appropriate to the frequency shall be used. For frequencies above 1 GHz, any suitable measuring distance may be used. The equipment size (excluding the antenna) shall be less than 20 % of the measuring distance. The height of the equipment or of the substitution antenna shall be 1,5 m; the height of the test antenna (transmit or receive) shall vary between 1 and 4 m.

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 according to CISPR 16-1 [6];
- 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.

The general measurement arrangement is shown in figure A.1.



- 1) equipment under test
- 2) test antenna
- 3) high pass filter (as required)
- 4) spectrum analyser or measuring receiver

Figure A.1: Measuring arrangement

A.1.2 Anechoic chamber

A.1.1.1 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. Absolute or relative measurements may be performed on transmitters or on receivers. Absolute measurements of field strength require a calibration of the anechoic chamber. The test antenna, UUT 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.

A.1.1.2 Description

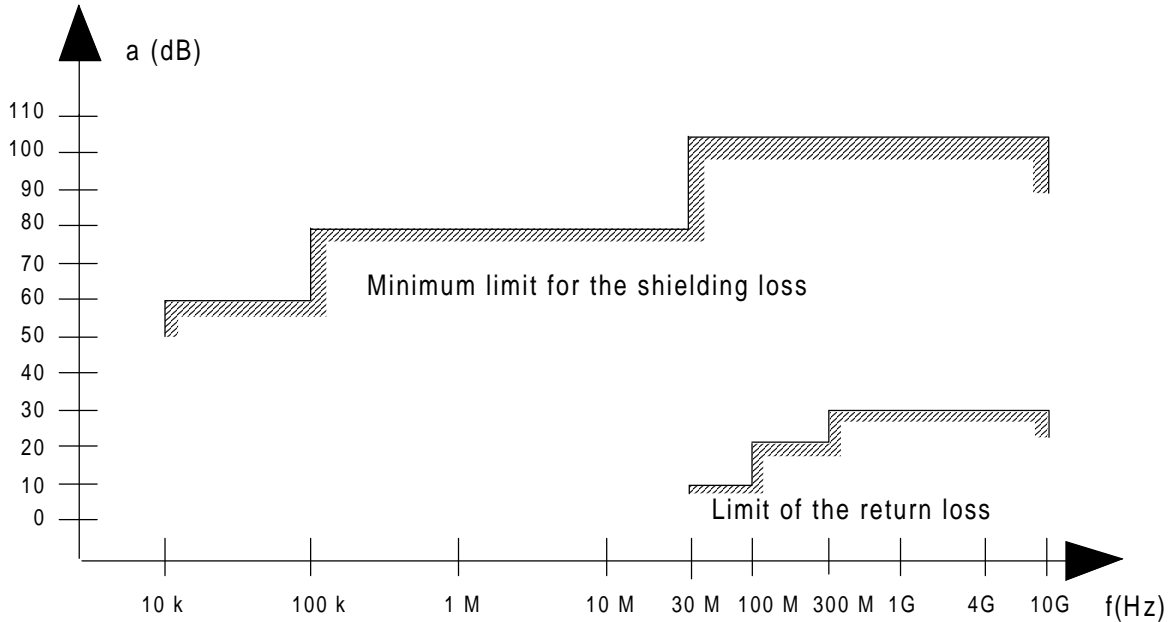


Figure A.2: Specification for shielding and reflections

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

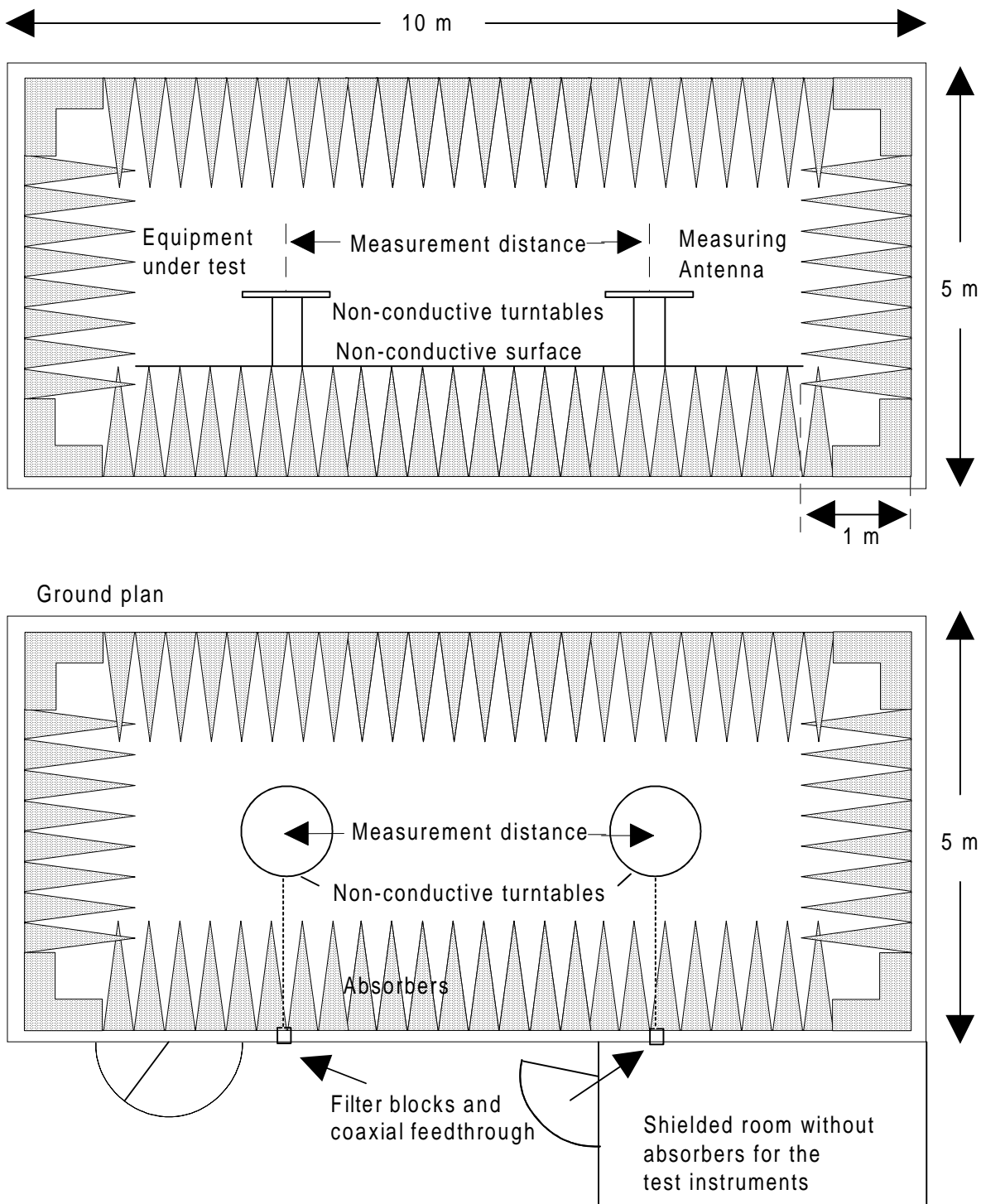


Figure A.3: Anechoic shielded chamber for simulated free space measurements

A.1.1.3 Influence of parasitic reflections

For free-space propagation in the far field, the relationship of the field strength E and the distance R is given by $E = E_0 \times (R_0/R)$, where E_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 foregoing equation is used, the deviation from the ideal curve may 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.

A.1.1.4 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.

A.2 Test antenna

When the test site is used for radiation measurements the test antenna shall be used to detect the field from both the test sample and the substitution antenna. When the test site is used for the measurement of receiver characteristics the antenna shall be used as a transmitting antenna. This antenna shall be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization 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.

A.3 Substitution antenna

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

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

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

Annex B (normative): General description of measurement

This annex gives the general methods of measurements for RF signals using the test sites and arrangements described in annex A.

B.1 Conducted measurements

Conducted measurements may be applied to equipment provided with an antenna connector e.g. by means of a spectrum analyser.

B.2 Radiated measurements

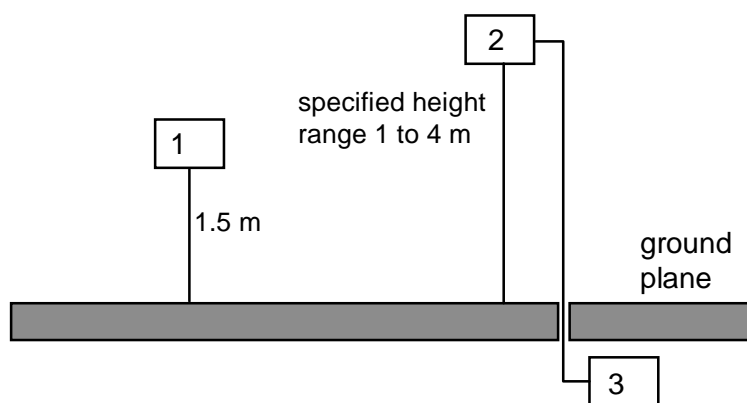
Radiated measurements shall be performed with the aid of a test antenna and measurement instruments as described in annex A. The test antenna and measurement instrument shall be calibrated according to the procedure defined in this annex. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level. This position shall be recorded in the measurement report. The frequency range shall be measured in this position.

Radiated measurements should be performed in an anechoic chamber. For other test sites corrections may be needed (see annex A). The following test procedure applies:

- a) a test site which fulfils the requirements of the specified frequency range of this measurement shall be used. The test antenna shall be oriented initially for vertical polarization unless otherwise stated and the transmitter under test shall be placed on the support in its standard position (subclause A.1.1) and switched on;
- b) for average power measurements a non-selective voltmeter or wide band spectrum analyser shall be used. For other measurements a spectrum analyser or selective voltmeter shall be used and tuned to the measurement frequency.

In either case a) or b), the test antenna shall be raised or lowered, if necessary, through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to subclause A.1.2.



- 1) equipment under test
- 2) test antenna
- 3) spectrum analyser or measuring receiver

Figure B.1: Measurement arrangement 1

- c) the transmitter shall be rotated through 360° about a vertical axis until a higher maximum signal is received;

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

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

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to subclause A.1.2. This measurement shall be repeated for horizontal polarization. The result of the measurement shall be taken as the sum of the powers measured with vertical and horizontal polarization.

B.3 Substitution measurement

The actual signal generated by the measured equipment may be determined by means of a substitution measurement in which a known signal source replaces the device to be measured, see figure B.2.

This method of measurement should be used in an anechoic chamber. For other test sites corrections may be needed, see annex A.

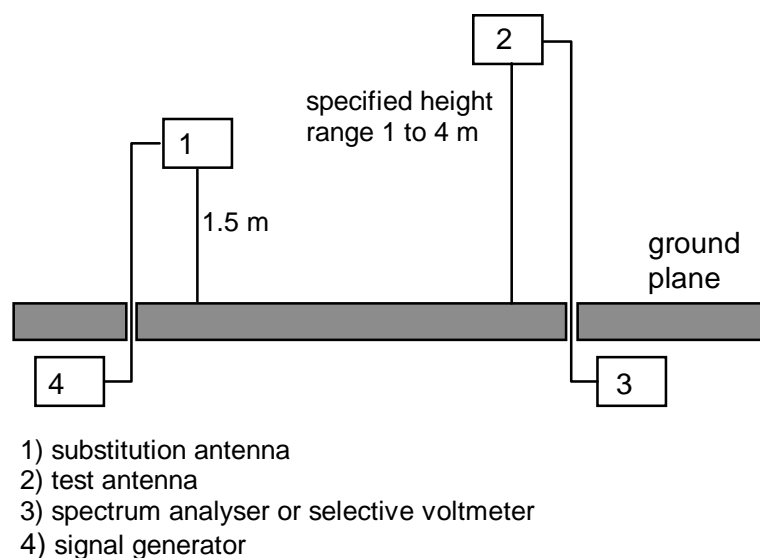


Figure B.2: Measurement arrangement N82

- a) using measurement arrangement 2, figure B.2, the substitution antenna shall replace the transmitter antenna in the same position and in vertical polarization. The frequency of the signal generator shall be adjusted to the measurement frequency. The test antenna shall be raised or lowered, if necessary, to ensure that the maximum signal is still received. The input signal to the substitution antenna shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to subclause A.1.2.

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

This measurement shall be repeated with horizontal polarization. The result of the measurement shall be taken as the sum of the powers measured with vertical and horizontal polarization.

Annex C (normative): Description of Protocol Data Unit (PDU) sequences for test use

This normative annex specifies certain frame transmission sequences and reception scenarios for use during HIPERLAN radio conformance and type approval testing. These sequences are referenced in the main document using the test sequence names given below.

C.1 Transmitter testing measurement test sequence (user specified channel number)

Test sequence name: TS_T1

C.1.1 Transmission conditions and pre-conditions

Table C.1: Transmission conditions and pre-conditions, TS_T1

Other HIPERLAN nodes:	UUT and SS only, no others present.
SS noise and interference:	None shall be generated.
Channel permission procedure:	The SS shall generate CP-HCPDUs as defined in ETS 300 652 [1] subclause 8.3 except that, for the purposes of this test, it need only transmit CP-HCPDUs on the channel used for the test.
Look up procedure:	The UUT and SS shall be configured with the same HIPERLAN IDentifier (HID) and HN.
Sleep compatibility:	Transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the HIPERLAN UUT.
HIPERLAN UUT configuration:	Unspecified
HIPERLAN SS Frequency error:	None to the accuracy of the SS
HIPERLAN SS Data rate error:	None to the accuracy of the SS
Channel number:	0 - 4 as defined elsewhere in this document

C.1.2 PDUs transmitted by the UUT, common characteristics

Table C.2: PDUs transmitted by the UUT, common characteristics, TS_T1

PDU Type:	Multicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source MSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Source HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Any group-MSAP-address that includes the SS
PDU Destination HCSAP Address:	All_Neighbours
PDU residual lifetime:	Unspecified
PDU User Priority:	Default value
PDU amount of user data:	19 064 bits (= maximum length PDU)
PDU content of user data:	Frames shall contain random user data

C.1.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: HIPERLAN UUT to send PDUs continuously as required to make transmitter measurements.

C.1.4 Other SS Activity during sequence reception:

Take UUT transmitter measurements as defined in the relevant parts of this document. No ACK is required to be transmitted by the SS, since the UUT transmits multicast frames.

C.2 Transmission deferral test sequence

Test sequence name: TS_T2.

C.2.1 Transmission conditions and pre-conditions

Table C.3: Transmission conditions and pre-conditions, TS_T2

Other HIPERLAN nodes:	UUT and SS only, no others shall be present.
SS noise and interference:	During the test, the SS shall transmit random noise at a power level of -72 dBm as defined in ETS 300 652 [1] subclauses 9.4, 9.4.1 and 9.9.2 (-72 dBm includes a 3dB allowance for the permissible tolerance defined in table 42).
Channel permission procedure:	The SS shall generate CP-HCPDUs as defined in ETS 300 652 [1] subclause 8.3 except that, for the purposes of this test, it need only transmit CP-HCPDUs on the channel used for the test.
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	Transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the UUT.
HIPERLAN UUT configuration:	The test sequence TS_T2 shall only apply if the ADT feature is not implemented.
HIPERLAN SS Frequency error:	None to the accuracy of the SS
HIPERLAN SS Data rate error:	None to the accuracy of the SS
Channel number:	2 only

C.2.2 PDUs transmitted by the UUT, common characteristics

Table C.4: PDUs transmitted by the UUT, common characteristics, TS_T2

PDU Type:	Multicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source MSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Source HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Any group-MSAP-address that includes the SS
PDU Destination HCSAP Address:	All_Neighbours
MSDU lifetime:	Default value
PDU User Priority:	Default value
PDU amount of user data:	19 064 bits (= maximum length PDU)
PDU content of user data:	Frames shall contain random user data

C.2.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: UUT to be commanded to send PDUs continuously.

C.2.4 Other SS Activity during sequence reception:

Ensure that the HIPERLAN UUT does not transmit during the test, whilst the SS generates random noise at the power level specified.

C.3 Transmission deferral test sequence, (MADT)

Test sequence name: TS_T3

C.3.1 Transmission conditions and pre-conditions:

Table C.5: Transmission conditions and pre-conditions, TS_T3

Other HIPERLAN nodes:	UUT and SS only, no others shall be present.
SS noise and interference:	During the test, the SS shall transmit random noise at variable power levels corresponding to a range of received signal strengths between SLN 10 and SLN 20, (see ETS 300 652 [1] subclause 9.9.2). The received signal strength shall change not more frequently than every 1 millisecond. During any 5 millisecond interval, the received signal strengths generated by the SS shall include at least SLN 10 and SLN 20.
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	Transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the UUT.
HIPERLAN SS Frequency error:	None to the accuracy of the SS.
HIPERLAN SS Data rate error:	None to the accuracy of the SS.
Channel number:	2 only

C.3.2 PDUs transmitted by the UUT, common characteristics

Table C.6: PDUs transmitted by the UUT, common characteristics, TS_T3

PDU Type:	Multicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source MSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Source HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Any group-MSAP-address that includes the SS
PDU Destination HCSAP Address:	All_Neighbours
MSDU lifetime:	Default value
PDU User Priority:	Default value
PDU amount of user data:	As required.
PDU content of user data:	Frames shall contain random user data

C.3.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: HIPERLAN UUT shall be commanded to send PDUs continuously.

C.3.4 Other SS activity:

To ensure that the UUT transmits only whilst the signal strength generated by the SS is lower than or equal to SLN 12, the SS shall record the signal strength when the SS detects a transmission from the UUT.

C.4 Transmission deferral test sequence, (MADT maximum value)

Test sequence name: TS_T4.

C.4.1 Transmission conditions and pre-conditions

Table C.7: Transmission conditions and pre-conditions, TS_T4

Other HIPERLAN nodes:	UUT and SS only, no others shall be present.
SS noise and interference:	During the test, the SS shall transmit random noise at variable power levels corresponding to a range of received signal strengths between SLN 23 and SLN 31, (see ETS 300 652 [1] subclause 9.9.2). The received signal strength shall change not more frequently than every 1 millisecond. During any 5 millisecond interval, the received signal strengths generated by the SS shall include at least SLN 23.
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	Transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the HIPERLAN UUT.
HIPERLAN SS Frequency error:	None to the accuracy of the SS
HIPERLAN SS Data rate error:	None to the accuracy of the SS
Channel number:	2 only

C.4.2 PDUs transmitted by the UUT, common characteristics

Table C.8: PDUs transmitted by the UUT, common characteristics, TS_T4

PDU Type:	Multicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source MSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Source HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Any group-MSAP-address that includes the SS
PDU Destination HCSAP Address:	All_Neighbours
MSDU lifetime:	Default value
PDU User Priority:	Default value
PDU amount of user data:	As required.
PDU content of user data:	Frames shall contain random user data

C.4.3 Transmitted PDU sequence characteristics

Number of PDUs transmitted: HIPERLAN UUT shall be commanded to send PDUs continuously.

C.4.4 Other SS Activity:

To ensure that the HIPERLAN UUT never transmits, the SS shall detect any transmission from the UUT.

C.5 Basic receiver FER measurement test sequence, (channel 4)

Test sequence name: TS_R1

C.5.1 Transmission conditions and pre-conditions

Table C.9: Transmission conditions and pre-conditions, TS_R1

Other HIPERLAN nodes:	UUT and SS only, no others shall be present.
SS noise and interference:	None shall be generated.
Channel permission procedure:	The SS shall generate CP-HCPDUs as defined in ETS 300 652 [1] subclause 8.3 except that, for the purposes of this test, it need only transmit CP-HCPDUs on channel 4.
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	SS transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the HIPERLAN UUT.
HIPERLAN UUT configuration:	Unspecified
HIPERLAN SS frequency error:	None to the accuracy of the SS
HIPERLAN SS data rate error:	None to the accuracy of the SS
Channel number:	4 (note)
NOTE:	This is the highest carrier frequency, and a non-default channel.

C.5.2 Transmitted PDUs common characteristics:

Table C.10: PDUs transmitted by the UUT, common characteristics, TS_R1

PDU Type:	Unicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source HCSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Source MSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Destination HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Neither SS or UUT address, (prevents delivery by the MAC)
PDU residual lifetime:	0, (prevents forwarding).
PDU User Priority:	Default value
PDU amount of user data:	4 160 bits
PDU content of user data:	25% of frames shall contain random user data including a 128 sequence of zeros and a further 25% of frames shall contain random user data including a sequence of 128 ones. The other 50% shall contain random data. See ETS 300 652 [1] subclause 9.9.3.5.

C.5.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: 10 000

C.5.4 Other SS activity during sequence transmission:

Check and count the number of authentic LBR ACKs received back from the HIPERLAN UUT during sequence transmission.

C.6 Long frame, receiver FER measurement test sequence

Test sequence name: TS_R2

C.6.1 Transmission conditions and pre-conditions

Table C.11: Transmission conditions and pre-conditions, TS_R2

Other HIPERLAN nodes:	UUT and SS only, no others present.
SS noise and interference:	None shall be generated.
Channel permission procedure:	The SS shall not generate CP-HCPDUs
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	SS transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the HIPERLAN UUT.
HIPERLAN UUT configuration:	Unspecified
HIPERLAN SS Frequency error:	None to the accuracy of the SS
HIPERLAN SS Data rate error:	None to the accuracy of the SS
Channel number:	2

C.6.2 Transmitted PDUs common characteristics

Table C.12: PDUs transmitted by the UUT, common characteristics, TS_R2

PDU Type:	Unicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source HCSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Source MSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Destination HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Neither SS or UUT address, (prevents delivery by the MAC)
PDU residual lifetime:	0, (prevents forwarding).
PDU User Priority:	Default value
PDU amount of user data:	19 064 bits (= maximum length PDU)
PDU content of user data:	25% of frames shall contain random user data including a 128 sequence of zeros and a further 25% of frames shall contain random user data including a sequence of 128 ones. The other 50% shall contain random data. See ETS 300 652 [1] subclause 9.9.3.5.

C.6.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: 10,000

C.6.4 Other SS Activity during sequence transmission:

Check and count the number of authentic LBR ACKs received back from the HIPERLAN UUT during sequence transmission if appropriate.

C.7 Receiver FER with frequency and data rate error test sequence

Test sequence name: TS_R3

C.7.1 Transmission conditions and pre-conditions

Table C.13: Transmission conditions and pre-conditions, TS_R3

Other HIPERLAN nodes:	UUT and SS only, no others present.
SS noise and interference:	None shall be generated.
Channel permission procedure:	The SS shall not generate CP-HCPDUs
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	SS transmission shall occur during the UUT wake period, or if this time is insufficient, spread over several wake periods of the HIPERLAN UUT.
HIPERLAN UUT configuration:	Unspecified
HIPERLAN SS Frequency error:	SS shall transmit PDUs alternately with a per unit frequency error of +10ppm and -10ppm
HIPERLAN SS Data rate error:	SS shall transmit the HBR part of HCPDUs with a per unit data rate error the same as the frequency error for the current HCPDU.
Channel number:	0

C.7.2 Transmitted PDUs common characteristics

Table C.14: PDUs transmitted by the UUT, common characteristics, TS_R3

PDU Type:	Unicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	none shall be used
PDU Source HCSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Source MSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Destination HCSAP Address:	UUT HIPERLAN 48 bit LAN MAC address
PDU Destination MSAP Address:	Neither SS or UUT address, (prevents delivery by the MAC)
PDU residual lifetime:	0, (prevents forwarding).
PDU User Priority:	Default value
PDU amount of user data:	4 160 bits
PDU content of user data:	25% of frames shall contain random user data including a 128 sequence of zeros and a further 25% of frames shall contain random user data including a sequence of 128 ones. The other 50% shall contain random data. See ETS 300 652 [1] subclause 9.9.3.5.

C.7.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: 10,000

C.7.4 Other SS Activity during sequence transmission:

Check and count the number of authentic LBR ACKs received back from the HIPERLAN UUT during sequence transmission.

C.8 Receiver emissions and adjacent channel test sequence, (channel 3)

Test sequence name: TS_R4

C.8.1 Transmission conditions and pre-conditions

Table C.15: Transmission conditions and pre-conditions, TS_R4

Other HIPERLAN nodes:	UUT and SS only, no others present.
SS noise and interference:	None shall be generated.
Channel permission procedure:	The SS shall generate CP-HCPDUs as defined in ETS 300 652 [1] subclause 8.3 except that, for the purposes of this test, it need only transmit CP-HCPDUs on channel 3.
Look up procedure:	The UUT and SS shall be configured with the same HID and HN.
Sleep compatibility:	SS transmission shall be continuous.
HIPERLAN UUT configuration:	Unspecified
HIPERLAN SS frequency error:	None to the accuracy of the SS
HIPERLAN SS data rate error:	None to the accuracy of the SS
Channel number:	3, (Note this a non-default channel).

C.8.2 Transmitted PDUs common characteristics

Table C.16: PDUs transmitted by the UUT, common characteristics, TS_R4

PDU Type:	Multicast DT HMPDU
PDU HIPERLAN ID, (HID):	Configured to be the same as SS
Encryption:	None shall be used
PDU Source HCSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Source MSAP Address:	SS HIPERLAN 48 bit LAN MAC address
PDU Destination HCSAP Address:	Any group MSAP address that includes the UUT
PDU Destination MSAP Address:	All_Neighbours
PDU residual lifetime:	0, (prevents forwarding by the UUT)
PDU User Priority:	Default value
PDU amount of user data:	4 160 bits
PDU content of user data:	25% of frames shall contain random user data including a 128 sequence of zeros and a further 25% of frames shall contain random user data including a sequence of 128 ones. The other 50% shall contain random data. See ETS 300 652 [1] subclause 9.9.3.5.
During receiver selectivity testing, the user data of the two test sequences used shall be statistically independent.	

C.8.3 Transmitted PDU sequence characteristics:

Number of PDUs transmitted: Transmission shall be continuous to allow time for measurements to be completed.

C.8.4 Other SS activity during sequence transmission:

Take receiver emissions measurements if appropriate. This sequence is also used to generate adjacent channel interference during receiver selectivity testing.

Annex D (normative): Subclauses of this ETS relevant for compliance with the essential requirements of relevant EC Council Directives

The tests listed in this ETS describe how HIPERLAN equipments shall be tested to comply with:

- a) Mandatory requirements given in the base standard, ETS 300 652 [1] under the environmental conditions specified in the base standard and additionally other conditions declared by the supplier where these are more severe than the conditions specified in the base standard, (see subclause 4.1).
- b) Mandatory requirements given in the base standard, ETS 300 652 [1] related to optional features permitted by the base standard for inclusion in the UUT, for example the adaptive defer threshold feature.

Table D.1 identifies which clauses of this ETS relate to the essential requirements of relevant EC Council Directives. These tests shall be carried out by an accredited third-party test house. All other tests in this ETS, not listed in table D.1 may be carried out either by an accredited third-party test house or by the equipment supplier. Where the equipment supplier carries out the tests not listed in table D.1, compliance shall be established by a supplier declaration.

Table D.1: Subclauses of this ETS relevant for compliance with the essential requirements of relevant EC Council Directives

Clause/subclause number and title		Corresponding article of Council Directive 89/336/EEC	Qualifying remarks
6	Transmitter		
6.3	Output spectrum due to modulation and switching	4(a)	
6.4	Unwanted emissions outside the HIPERLAN bands	4(a)	
7	Receiver		
7.5	Receiver unwanted emissions	4(a)	

Annex E (informative): Bibliography

- ETR 069 (1993): "Radio Equipment and Systems (RES); High Performance Radio Local Area Network (HIPERLAN); Services and facilities".
- ETR 226 (1995): "Radio Equipment and Systems (RES); High Performance Radio Local Area Networks (HIPERLAN); Architecture for Time Bound Services (TBS)".
- ETR 027: "Radio Equipment and Systems (RES); Methods of measurement for private mobile radio equipment".
- ETR 028: "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".
- IEC 489-3: (1988) "Methods of measurement for radio equipment used in the mobile services - Receivers for A3E of F3E transmissions", Appendix F pages 130 to 133 and Appendix J pages 156 to 164.
- Ketterling, H.-P.: "Verification of the performance of fully and semi-anechoic chambers for radiation measurements and susceptibility/immunity testing", 1991, Leatherhead/Surrey, ERA Report 91-0028.

History

Document history			
February 1997	Public Enquiry	PE 9724:	1997-02-14 to 1997-06-13
February 1998	Vote	V 9817:	1998-02-24 to 1998-04-24
May 1998	First Edition		