ETSI EN 301 091-1 V2.1.1 (2017-01)

~~Electromagnetic compatibility~~
~~and Radio spectrum Matters (ERM);~~
Short Range Devices;
~~Road~~ Transport and Traffic Telematics (~~RTTT~~TTT);
Radar equipment operating in the 76 GHz to 77 GHz range;
~~Part 1: Technical characteristics and test methods for radar equipment operating in the 76 GHz to 77 GHz range~~

Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU;
Part 1: Ground based vehicular radar

Reference
REN/ERM-TGSRR-69

Keywords
harmonised standard, radar, radio, ~~testing, SRD, RTTT, short range~~

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Contents

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Foreword

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

~~For non EU countries the present document may be used for regulatory (Type Approval) purposes.~~

~~Where equipment compliant with~~The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.6] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.3].

Once the present document is ~~intended for fitment into vehicles, then it is subject to automotive EMC type approval under directive 2004/104/EC [5]. For use on vehicles outside~~cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of ~~2004/104/EC [5] another EMC directive/standard appropriate for that use is required~~the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

The present document is part 1 of a multi-part deliverable covering ~~Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Road~~ Transport and Traffic Telematics (~~RTTT~~TTT); Radar equipment operating in the 76- GHz to 77 GHz range, as identified below:

Part 1: "**~~Technical characteristics and test methods for radar equipment operating in the 76 GHz to 77 GHz range~~Ground based vehicular radar**";

Part 2: "~~Harmonized EN covering essential requirements of article~~Fixed infrastructure radar equipment";

Part 3~~.2 of the R&TTE Directive~~: "Railway/Road Crossings obstacle detection system applications".

National transposition dates	
Date of adoption of this EN:	23 January 2017
Date of latest announcement of this EN (doa):	30 April 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 October 2017
Date of withdrawal of any conflicting National Standard (dow):	31 October 2018

Modal verbs terminology

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

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document, together with ETSI EN 303 396 [1], covers the assessment of certain types of equipment as defined herein.

1 Scope

The present document specifies technical characteristics and methods of measurements for radar equipment for ground based vehicle applications in the frequency range from 76 GHz to 77 GHz. It covers integrated transceivers and separate transmit/receive modules.

Also the present document specifies the requirements for Short Range Devices (SRD) intended for ~~Road Transport and Traffic Telematics (RTTT)~~the use in ground based vehicles. Example applications ~~such as Automotive~~are: Adaptive Cruise Control (ACC), Collision Warning ~~(CW),~~ Anti-Collision (AC) systems, obstacle detection, Stop and Go, blind spot detection, parking aid, backup aid and other ~~automotive~~future applications.

~~The document applies to:~~

~~a) transmitters operating in the range from 76 GHz to 77 GHz;~~

~~b) receivers operating in the range from 76 GHz to 77 GHz.~~

NOTE 1: The definition of "ground based vehicle" includes but is not limited to passenger cars, busses, trucks, rail engines, ships, aircraft while taxing.

NOTE 2: High safety ratings (e.g. Euro NCAP) can only be obtained if such radar based safety applications are installed in a vehicle.

NOTE 3: Euro NCAP organizes crash-tests and provides motoring consumers with a realistic and independent assessment of the safety performance of some of the most popular cars sold in Europe.
Established in 1997, Euro NCAP is composed of seven European Governments as well as motoring and consumer organizations in every European country.

The present document contains the technical characteristics and test methods for ~~automotive~~ground based vehicle radar equipment fitted with integral antennas operating in the frequency range from 76 GHz to 77 GHz and references CEPT/ERC/ECC Recommendation ~~for SRDs, CEPT/ERC/ECC Recommendation~~ 70-03 [i.1] and ~~CEPT/ECC Decision (02)01~~EC DEC 2013/752/EU [~~2~~i.2].

The present document does not necessarily include all the characteristics which may be required by a user, nor does it necessarily represent the optimum performance achievable.

~~The~~ In case of differences (for instance concerning special conditions, definitions, abbreviations) between the present document ~~covers automotive radars for mobile applications in the frequency range from 76 GHz to 77 GHz. It covers integrated transceivers~~ and ~~separate transmit/receive modules.~~

~~The~~ETSI EN 303 396 [1], the provisions of the present document ~~covers only~~take precedence.

~~—~~These radio equipment ~~for road vehicles.~~

~~There~~types are ~~two classes defined within the present document: Class 1 (e.g. FM, CW~~capable of operating in all or ~~FSK) and Class 2 (pulsed Doppler radar only). The difference between the two class numbers is the permitted average power level.~~ part of the frequency bands given in table 1.

Table 1: Permitted range of operation [i.2]

Permitted range of operation	
Transmit	76 GHz to 77 GHz
Receive	76 GHz to 77 GHz

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.3] under the conditions identified in annex A.

2 References

2.1 Normative references

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

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

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

[1] ETSI EN 303 396 (V1.1.1) (12-2016): "Short Range Devices; Measurement Techniques for Automotive and Surveillance Radar Equipment".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

[i.1] CEPT/ERC Recommendation 70-03 (2005):: "Relating to the use of Short Range Devices (SRD)".

[[i.2] CEPT/ECC/DEC(02)01: "ECCEC Decision 2013/752/EU: "Commission implementing Decision of 15 March 200211 December 2013 amending Decision 2006/771/EC on harmonisation of the frequency bands to be designatedradio spectrum for the coordinated introduction of Road Transportuse by short-range devices and Traffic Telematic Systemsrepealing Decision 2005/928/EC".

[[i.3] CISPR 16: "Specifications for radio disturbance and immunity measuring apparatus and methods".

[4] ETSI TR 100 028 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[5] Directive 2004/104/EC of 14 October 2004, adapting to technical progress2014/53/EU of the European Parliament and of the Council Directive 72/245/EEC, relating to the radio interference (electromagnetic compatibility) of vehicles and amending Directive 70/156/EC on the approximationof 16 April 2014 on the harmonisation of the laws of the Member States relating to the type approval of motor vehicles and their trailers (OJL 337, 13.11.204).making available on the market of radio equipment and repealing Directive 1999/5/EC.

[[i.4] ETSI TR 102 273-2] CEPT/ERC/REC 74-01: "Unwanted emissions in the spurious domain".

[i.5] ETSI EG 203 336: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site)Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

[i.6] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[7] CEPT/ERC Recommendation 01-06: "Procedure for mutual recognition of type testing and type approval for radio equipment".

[8] CEPT/ERC/Recommendation 74-01: "Unwanted emissions in the spurious domain".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions given in ETSI EN 303 396 [1] and the following apply:

antenna cycle: one complete sweep of a mechanically or electronically scanned antenna beam along a predefined spatial path

antenna scan duty factor: ratio of the area of the beam (measured at its 3 dB point) to the total area scanned by the antenna (as measured at its 3 dB point)

assigned frequency band: frequency band within which the device is authorized to operate

associated antenna: antenna and all its associated components which are designed as an indispensable part of the equipment

average time: time interval on which a mean measurement is integrated

blanking period: time period where no intentional emission occurs

duty cycle: the ratio of the total on time of the "message" to the total off time in any one hour period

dwell time: accumulated amount of transmission time of uninterrupted continuous transmission within a single given frequency channel and within one channel repetition interval

Equipment Under Test (EUT): radar sensor including the integrated antenna together with any external antenna components which affect or influence its performance

equivalent isotropically radiated power (e.i.r.p.): total power or power density transmitted, assuming an isotropic radiator

NOTE: e.i.r.p. is conventionally the product of "power or power density into the antenna" and "antenna gain". e.i.r.p. is used for both peak or average power and peak or average power density.

equivalent pulse power duration: duration of an ideal rectangular pulse which has the same content of energy compared with the pulse shape of the EUT with pulsed modulation or time gating

far field measurements: measurement distance should be a minimum of $2d^2/\lambda$, where d = largest dimension of the antenna aperture of the EUT and λ is the operating wavelength of the EUT

mean power: supplied from the antenna during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions

NOTE: For pulsed systems the mean power is equal the peak envelope power multiplied by the time gating duty factor. For CW systems without further time gating the mean power is equal the transmission power without modulation.

on-off gating: methods of transmission with fixed or randomly quiescent period that is much larger than the PRF

operating frequency (operating centre frequency): nominal frequency at which equipment is operated

NOTE: Equipment may be able to operate at more than one operating frequency.

operating frequency range: range of operating frequencies over which the equipment can be adjusted through switching or reprogramming or oscillator tuning

NOTE 1: For pulsed or phase shifting systems without further carrier tuning the operating frequency range is fixed on a single carrier line.

NOTE 2: For analogue or discrete frequency modulated systems (FSK, FMCW) the operating frequency range covers the difference between minimum and maximum of all carrier frequencies on which the equipment can be adjusted.

peak envelope power: mean power (round mean square for sinusoidal carrier wave type) supplied from the antenna during one radio frequency cycle at the crest of the modulation envelope taken under normal operating conditions

Power Spectral Density (PSD): ratio of the amount of power to the used radio measurement bandwidth

NOTE: It is expressed in units of dBm/Hz or as a power in unit dBm with respect to the used bandwidth. In case of measurement with a spectrum analyser the measurement bandwidth is equal to the RBW.

Pulse Repetition Frequency (PRF): inverse of the Pulse Repetition Interval, averaged over a time sufficiently long as to cover all PRI variations

Pulse Repetition Interval (PRI): time between the rising edges of the transmitted (pulsed) output power

quiescent period: time instant where no emission occurs

radiated spurious emissions: Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

radome: external protective cover which is independent of the associated antenna, and which may contribute to the overall performance of the antenna (and hence, the EUT)

spatial radiated power density: power per unit area normal to the direction of the electromagnetic wave propagation

NOTE: It is expressed in units of W/m^2.

spread spectrum modulation: modulation technique in which the energy of a transmitted signal is spread throughout a relatively large portion of the frequency spectrum

steerable antenna: Directional antenna which can sweep its beam along a predefined spatial path. Steering can be realized by mechanical, electronical or combined means. The antenna beamwidth may stay constant or change with the steering angle, dependent on the steering method.

ground based vehicle: includes but is not limited to passenger cars, buses, trucks, rail engines, trams, ships, construction vehicles and aircraft while taxiing

NOTE: For details see CEPT/ERC Recommendation 70-03 [i.1].

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 303 396 [1] and the following symbols apply:

λ	wavelength
1/P	repetition rate of the modulation wave form
ac	alternating current
B	bandwidth
d	largest dimension of the antenna aperture
D	antenna scan duty factor
D_{fb}	distance between ferrite beads
dB	decibel
dBi	gain in decibels relative to an isotropic antenna
df	spectral distance between 2 lines with similar power levels
Afmax	maximum frequency shift between any two frequency steps
Afmin	minimum frequency shift between any two frequency steps

~~E field strength~~
~~E_θ reference field strength~~
~~G blank time period~~
~~P period of time during in which one cycle of the modulation wave form is completed~~
~~P_a mean power within the BW~~
~~P_L power of an individual spectral line~~
~~P_{rad} radiated power~~
~~R distance~~
~~R_θ reference distance~~
~~τ pulse width~~
~~T_c chip period~~

3.3 Abbreviations

For the purposes of the present document, the ~~following~~ abbreviations given in ETSI EN 303 396 [1] and the following apply:

~~AC Anti-Collision~~
~~ACC Automotive Cruise Control~~
~~ASK Amplitude Shift Keying~~
~~CW Continuous Wave~~
~~DSS Direct Sequence Signal~~
e.~~i.~~r.p. equivalent ~~isotropically~~ radiated power
~~ECC Electronic Communications Committee~~
~~EMC ElectroMagnetic Compatibility~~
~~ERC European Radiocommunication Committee~~
~~EUT Equipment Under Test~~
~~FM Frequency Modulation~~
~~FMCW Frequency Modulated Continuous Wave~~
~~FMICW Frequency Modulated Interrupted Continuous Wave~~
~~FSK Frequency Shift Keying~~
~~IF Intermediate Frequency~~
~~OATS Open Area Test Site~~
~~PN Pseudo-Noise~~
~~PRF Pulse Repetition Frequency~~
~~PRI Pulse Repetition Interval~~
~~R&TTE Radio and Telecommunications Terminal Equipment~~
~~RBW Resolution Bandwidth~~
~~RF Radio Frequency~~
~~RMS Root Mean Square~~
~~RTTT Road Transport and Traffic Telematics~~
~~SRD Short Range Device~~
~~Tx Transmitter~~
~~VSWR Voltage Standing Wave Ratio~~

NCAP New Car Assessment Programme

4 Technical requirements specifications

4.1 ~~Equipment~~Environmental conditions

The technical requirements of the present document apply under the environmental profile for ~~testing purposes~~operation of the equipment, which shall be declared by the manufacturer. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile. The normal and extreme test conditions are defined in clauses 4.4.3 and 4.4.4 of ETSI EN 303 396 [1].

~~Each equipment submitted for testing, where applicable, shall fulfil the requirements of the present document on all frequencies over which it is intended to operate. EMC type approval testing to Directive 2004/104/EC [~~

4.2 General

4.2.1 Background information

In this clause general considerations for the testing of radar applications for ground based vehicle applications in the frequency range from 76 GHz to 77 GHz are given. The tests cover integrated transceivers and separate transmit/receive modules.

All operating bandwidths of the equipment (see clause 4.3.1) shall be declared by the equipment manufacturer (see clauses 4.2 and 4.3 of ETSI EN 303 396 [1]~~ shall be done on the vehicle.~~

~~The provider shall provide one or more samples of the equipment, as appropriate for testing.~~

~~Additionally, technical documentation and operating manuals, sufficient to allow testing to be performed, shall be supplied.~~

~~The performance of the equipment submitted for testing shall be representative of the performance of the corresponding production model. In order to avoid any ambiguity in that assessment, the present document contains instructions for the presentation of equipment for testing purposes, conditions of testing (see clause 5) and the measurement methods (see clauses 7 and 8).~~

~~Stand alone equipment for testing shall be offered by the provider complete with any ancillary equipment needed for testing. The provider shall declare the frequency range(s), the range of operation conditions and power requirements, as applicable, in order to establish the appropriate test conditions.~~

~~The EUT will comprise the sensor, antenna and radome if needed and will be tested as a stand alone assembly. The EUTs test fixtures may be supplied by the provider to facilitate the tests (see clause 6.1).~~

~~These clauses are intended to give confidence that the requirements set out in the document have been met without the necessity of performing measurements on all frequencies.~~

~~4.1.1 Choice of model for testing~~

~~If an equipment has several optional features, considered not to affect the RF parameters then the tests need only to be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the provider and agreed by the test laboratory.~~

~~4.2 Mechanical and electrical design~~

~~The equipment submitted by the provider 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.~~

~~Transmitters and receivers may be individual or combination units.~~

~~4.3 Auxiliary test equipment~~

~~All necessary test signal sources and set-up information shall accompany the equipment when it is submitted for testing.~~

~~4.4 Interpretation of the measurement results~~

~~]).~~

Where equipment has more than one operating bandwidths, sufficient number of operating bandwidths shall be chosen for testing so as to encompass the lower and higher limits of the operating frequency and the minimum and maximum bandwidth.

The meaning of EUT with scanning/steerable antenna is that the EUT TX antenna pattern is electronically or mechanically adjustable.

4.2.2 Wanted performance criteria

The wanted performance criterion is that the EUT shall indicate the properties of a given target at a given distance. Since EUT considered here typically are tailored to specific applications, no single wanted performance criterion can be defined here.

Therefore:

- the relevant properties (e.g. presence, range, relative speed, azimuth angle) shall be declared by the manufacturer;
- the type and RCS of the target and the distance shall be declared by the manufacturer.

4.2.3 Fixed and scanning antennas

The provisions of ETSI EN 303 396 [1], clause 4.3.5 apply.

4.3 Transmitter Conformance Requirements

4.3.1 Operating Frequency Range

4.3.1.1 Applicability

This requirement applies to all EUT.

4.3.1.2 Description

The description in ETSI EN 303 396 [1], clause 6.2.2 applies.

4.3.1.3 Limits

The upper and lower limits of the operating frequency range shall meet the following conditions:

- $f_H \leq 77$ GHz.
- $f_L \geq 76$ GHz.

4.3.1.4 Conformance

The conformance test for operating frequency range shall be as defined in clause 6.3.2 of ETSI EN 303 396 [1].

Conformance shall be established under normal and extreme test conditions defined in clause 4.1.

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

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

~~the measurement~~ uncertainty ~~value for the measurement of each parameter~~ shall be ~~included~~as given in ~~the test report;~~clause 4.6 of ETSI EN 303 396 [1].

- ~~the recorded value of the measurement uncertainty shall, for each measurement, be equal to, or lower than, the figures in the table of measurement uncertainty (see clause 9).~~

5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

Testing shall be made under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in clauses 5.2 to 5.4.

5.2 External test power source

During tests the power source of the equipment shall be an external test power source, capable of producing normal and extreme test voltages as specified in clauses 5.3.2 and 5.4.2. The internal impedance of the external test power source shall be low enough to be negligible for its effect on the test results.

The test voltage shall be measured at the point of connection of the power cable to the equipment.

During tests the external test power source voltages shall be within a tolerance of ±1 % relative to the voltage at the beginning of each test. The level of this tolerance can be critical for certain measurements. Using a smaller tolerance provides a reduced uncertainty level for these measurements.

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°C to +35°C;
- relative humidity: 20 % to 75 %.

When it is impracticable to carry out tests under these conditions, a note to this effect, stating the ambient temperature and relative humidity during the tests, shall be added to the test report.

5.3.2 Normal test power source

The internal impedance of the test power source shall be low enough to be negligible for its effect on the test results. For the purpose of the tests, the voltage of the external test power source shall be measured at the input terminals of the equipment.

5.3.2.1 Mains voltage

The normal test voltage for equipment shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages, for which the equipment was designed.

The frequency of the test power source corresponding to the ac mains shall be between 49 Hz and 51 Hz.

5.3.2.2 Other power sources

For operation from other power sources the normal test voltage shall be that declared by the provider. Such values shall be stated in the test report.

5.4 Extreme test conditions

5.4.1 Extreme temperatures

5.4.1.1 Procedure for tests at extreme temperatures

Before measurements are made, the equipment shall have reached thermal balance in the test chamber. The equipment shall not be switched off during the temperature stabilizing period.

If the thermal balance is not checked by measurements, a temperature stabilizing period of at least one hour, or such period as may be decided by the accredited test 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.

5.4.1.2 Extreme temperature ranges

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in clause 5.4.1.1, at the upper and lower temperatures of the following limits:

- temperature: -20°C to +55°C

5.4.2 Extreme test source voltages

5.4.2.1 Mains voltage

The extreme test voltages for equipment to be connected to an ac mains source shall be the nominal mains voltage ±10 %.

5.4.2.2 Other power sources

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be that declared by the provider. These shall be recorded in the test report.

6 General conditions

Detailed descriptions of the radiated measurement arrangements are included in annexes A and B. In general, measurements should be carried out under far field conditions; however, relative power measurements in the 76 GHz to 77 GHz frequency band could be carried out in the near field by using the test fixture as described in clause 6.1 and shown in figure

4.3.2 Mean Power

4.3.2.1 Applicability

This requirement applies to all EUT.

4.3.2.2 Description

The description in ETSI EN 303 396 [1.

The far field condition for the EUTs is considered to be fulfilled in a radial distance that shall be a minimum of $2d^2/\lambda$, where d = largest dimension of the antenna aperture of the EUT and λ is the operating wavelength of the EUT.

Absolute power measurements shall be made only in the far field. This prohibits the use of the test fixture shown in figure 1.

~~Each test site shall meet the appropriate requirements as defined in published guidelines/standards (e.g. for OATS, the requirements are defined in CISPR 16 [3]).~~

~~6.1 Test fixture~~

~~The test fixture for radio equipment operating in the 76 GHz to 77 GHz range enables the EUT to be physically supported, together with a wave guide horn antenna (which is used to couple/sample the transmitted energy), in a fixed physical relationship. The test fixture shall be designed for use in an anechoic environment and allows certain measurements to be performed in the near field. Only relative or comparative measurements may be performed, and only those at the frequencies in the 76 GHz to 77 GHz band over which the test fixture shall have been calibrated. A sketch of a test fixture is depicted in figure 1.~~

~~The test fixture incorporates at least one 50 Ω RF connector and a device for electromagnetic coupling to the EUT. It incorporates a means for repeatable positioning of the EUT. Its compactness enables the whole assembly to be accommodated within a test chamber, usually a climatic facility. The EUT can only be confidently tested after verification that the test fixture does not affect its performance.~~

~~At set-up, the EUT shall be aligned in the test fixture so that the maximum power is detected at the coupled output. Orientation of the horn antenna will take into account the polarization of the EUT.~~

~~In addition, the test fixture shall provide a connection to an external power supply.~~

~~The test fixture shall be provided by the provider together with a full description, which shall meet the approval of the selected accredited test laboratory.~~

~~The performance characteristics of the test fixture shall be measured and shall be approved by the accredited test laboratory. It shall conform to the following basic parameters:~~

- ~~the gain of the waveguide horn shall not exceed 20 dB;~~
- ~~the physical distance between the front face of the EUT and the waveguide horn shall be between 50 cm and 60 cm;~~
- ~~the physical height between the centre of the EUT and the supporting structure of the test fixture shall be between 50 cm and 60 cm;~~

~~NOTE: Information on uncertainty contributions, and verification procedures are detailed in clauses 5 and 6, respectively, of TR 102 273-2 [6].~~

- ~~circuitry associated with the RF coupling shall contain no active or non-linear devices;~~

~~the Voltage Standing Wave Ratio (VSWR) at the waveguide flange where measurements are made~~], clause 6.2.5 applies.

4.3.2.3 Limits

The mean power shall not be greater than ~~1,5: 1 over the frequency range of the measurements;~~the limits in table 2.

- ~~the performance of the test fixture when mounted in the anechoic environment on an open test site, or in a temperature chamber, shall be unaffected by the proximity of surrounding objects or people outside the environment. The performance shall be reproducible if the EUT is removed and then replaced;~~
- ~~the performance of the test fixture shall remain within the defined limits of the calibration report, when the test conditions are varied over the limits described in clauses 5.3 and 5.4.~~

~~6.1.1 Calibration~~

~~The calibration of the test fixture establishes the relationship between the detected output from the test fixture, and the transmitted power (as sampled at the position of the antenna) from the EUT in the test fixture. This can be achieved by using a calibrated horn with a gain of equal to or less than 20 dB, fed from an external signal source, in place of the EUT to determine the variations in detected power with temperature and over frequency.~~

The calibration of the test fixture shall be carried out by either the provider of the EUT or the accredited test laboratory. The results shall be approved by the accredited test laboratory.

The calibration shall be carried out over the operating frequency band, for at least three frequencies, for the declared polarization of the EUT, and over the temperature ranges specified in clause 5.4.1.2.

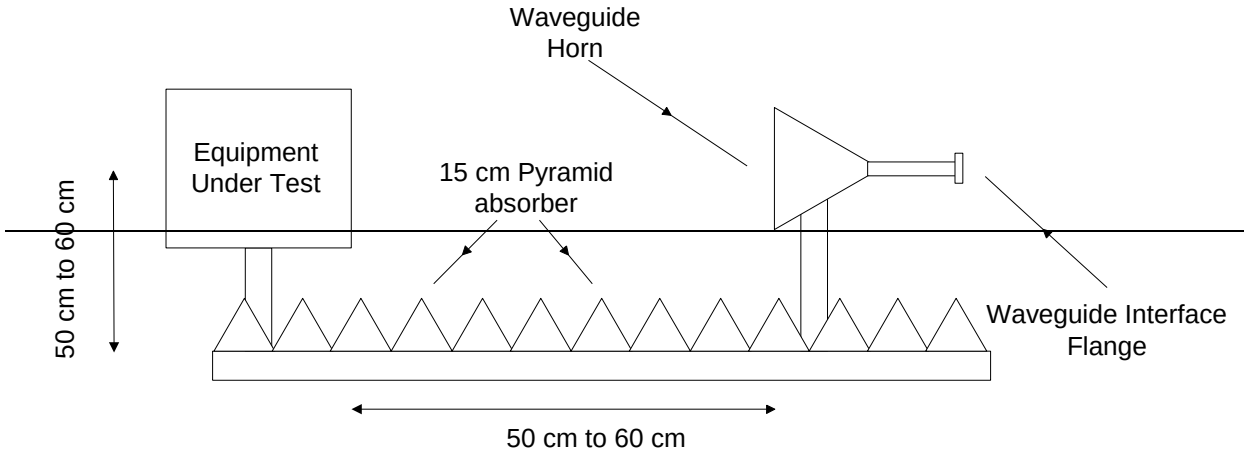


Figure 1: Test fixture

6.1.2 General requirements for RF cables and waveguides

All RF cables or waveguide interconnects, including their connectors at both ends, used within the measurement arrangements and set-ups shall adhere to the following characteristics:

- a nominal characteristic impedance of 50 Ω;
- a VSWR of less than 1,5 at either end;
- a shielding loss in excess of 60 dB.

All RF cables exposed to radiation shall be loaded with ferrite beads spaced at distance D_{fb} apart from each other along the entire length of the cable. Such cables are referred to as ferrited cables. The distance D_{fb} shall be smaller than half of the signal wavelength under test.

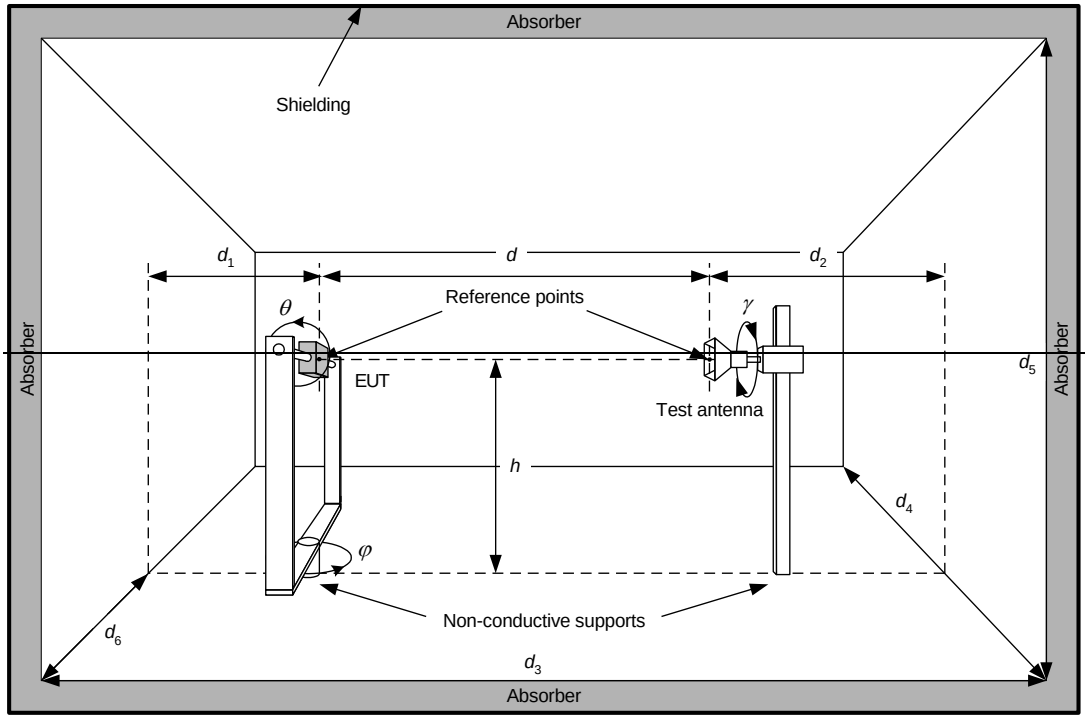
All RF cables and waveguide interconnects shall be routed suitably in order to reduce impacts on antenna radiation pattern, antenna gain, antenna impedance.

NOTE: Further details are provided in TR 102 273-2 [6].

6.1.3 Shielded anechoic chamber

A recommended test environment to be used as a test site is the shielded anechoic chamber.

A typical anechoic chamber is shown in figure 2. This type of test chamber attempts to simulate free space conditions.



~~Figure 2: Typical anechoic chamber~~

~~The chamber contains suitable antenna supports on both ends.~~

~~The supports carrying the test antenna and EUT shall be made of a non-permeable material featuring a low value of its relative permittivity.~~

~~The anechoic chamber shall be shielded. Internal walls, floor and ceiling shall be covered with radio absorbing material. The shielding and return loss for perpendicular wave incidence vs. frequency in the measurement frequency range shall meet:~~

- ~~105 dB shielding loss;~~
- ~~30 dB return loss.~~

~~Both absolute and relative measurements can be performed in an anechoic chamber. Where absolute measurements are to be carried out the chamber shall be verified. The shielded anechoic chamber test site shall be calibrated and validated for the frequency range being applicable.~~

~~NOTE: Information on uncertainty contributions, and verification procedures are detailed in clauses 5 and 6, respectively, of TR 102 273-2 [6].~~

~~Further information on shielded anechoic chambers is given in clause A.3.~~

~~7 Methods of measurement and limits for transmitter parameters~~

~~To meet the requirements for all applications the EUT shall be measured at its maximum peak and mean output power level and maximum antenna gain. Antenna polar diagrams, together with any antenna sweep profiles (for systems with antenna beam steering capability) and details of polarization, shall be presented and agreed with the accredited test laboratory if they are necessary to enable the measurements described in clause 7 to be performed.~~

~~The type of modulation has to be stated in the test specification.~~

Alternative test methods to those described within the present document may be used with the agreement of the manufacturer and at the discretion of the accredited test laboratory. Procedures shall comply with CEPT/ERC Recommendation 01-06 [7] and CISPR 16 [3].

There are two classes defined within the present document: class 1 (e.g. FM, CW or FSK) and class 2 (pulsed Doppler radar only). The only difference between the two class numbers is the permitted level of average power emission. The class is to be stated in the test report.

7.1 Permitted range of operating frequencies

7.1.1 Definition

The permitted range of operating frequencies is the frequency range over which the equipment is authorized to operate.

7.1.2 Method of measurement

The minimum and maximum output frequencies at which the permitted spurious and out-of-band emission levels as specified in clause 7.3 are exceeded due to intentional emission from the radio transmitter shall be measured using the method shown in figure 3. If the measuring receiver is capable of measuring the signals directly without any down mixing, the fundamental or harmonic mixer can be omitted. If more than one modulation scheme can be generated by the EUT, then the maximum and minimum frequencies generated by each modulation scheme shall be measured and recorded separately.

The measuring receiver may be a spectrum analyser, oscilloscope, selective power meter or any measuring receiver which is appropriate to perform the intended measurement of the EUT.

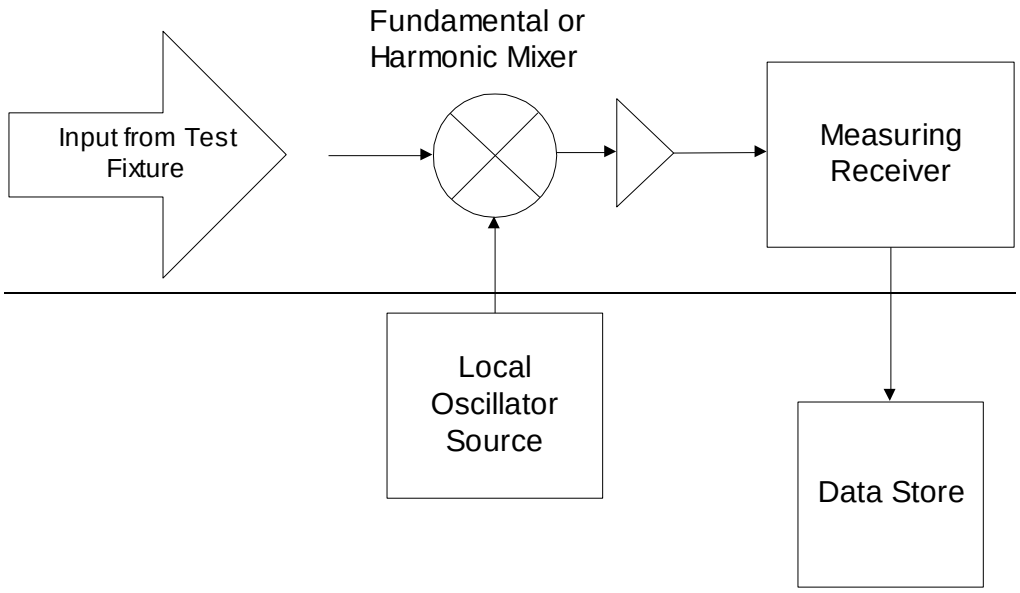


Figure 3: Test equipment for measuring the operating frequency range

This measurement shall be performed at normal and at extreme test conditions (see clauses 5.3 and 5.4).

The method of measurement shall be documented in the test report.

7.1.3 Limits

The permitted range of operating frequencies for intentional emissions shall be from 76 GHz to 77 GHz.

7.2 Radiated spatial power density

7.2.1 Definition

The radiated spatial power density is defined as the power per unit area normal to the direction of the electromagnetic wave propagation measured in the permitted range of operating frequencies (see clause 7.1) and is expressed as an e.i.r.p. (dBm).

7.2.2 Method of measurement

7.2.2.1 Equipment with a fixed beam antenna (i.e. non-steerable by either mechanical or electronic means)

Using an applicable measurement procedure, such as described in annexes A and B, the power output shall be measured and recorded in the test report. Absolute power measurements should be carried out under far field conditions, however measurements over temperature may be carried out using comparative measurements in the near field by using the test fixture as described in clause 6.1.

The method of measuring the spatial power density may be carried out either by the use of a calibrated power meter or by using a calibrated receiver. For all methods, the substitution technique described in annex B shall be used to calibrate the measuring equipment.

The polar diagram together with details of the polarization for the transmit beam (if required to enable the measurement to be carried out) shall be submitted by the provider and approved by the accredited test laboratory.

The maximum e.i.r.p. shall be recorded.

The e.i.r.p. shall be measured under far field conditions under normal test conditions (see clause 5.3). The limits for the e.i.r.p. are shown in table 1.

The e.i.r.p. under extreme test conditions (see clause 5.4) may be measured in the near field by using, for example, the test fixture defined in clause 6.1.

This measurement shall be carried out in an anechoic environment or may also be carried out at an OATS where no physical obstruction shall be within a sector defined as "three times the 3 dB beamwidth of the antenna" during this test.

This measurement shall be performed at normal and at extreme test conditions (see clauses 5.3 and 5.4).

The method of measurement shall be documented in the test report.

7.2.2.2 Equipment with (electronically or mechanically) steerable antenna(s)

Using an applicable measurement procedure, such as described in annexes A and B, the power output shall be measured and recorded in the test report. Absolute power measurements should be carried under far field conditions, however measurements over temperature may be carried out using comparative measurements in the near field by using the test fixture as described in clause 6.1.

The method of measuring the spatial power density may be carried out either by the use of a calibrated power meter or by using a calibrated receiver. For all methods, the substitution technique described in annex B shall be used to calibrate the measuring equipment.

Peak e.i.r.p. is to be measured using a standard gain horn and spectrum analyser set to slow sweep and peak hold mode. This enables the EUT to be fully tested according to clause 7.2.2.1. The peak e.i.r.p. shall be recorded. The manufacturer shall provide information relating to the scanning.

The e.i.r.p. shall be measured under far field conditions under normal test conditions (see clause 5.3). The limits for the e.i.r.p. are shown in table 2.

The e.i.r.p. under extreme test conditions (see clause 5.4) may be measured in the near field by using, for example, the test fixture defined in clause 6.1.

~~This measurement shall be carried out in an anechoic environment or may also be carried out at an OATS where no physical obstruction shall be within a sector defined as "three times the 3 dB beamwidth of the antenna" during this test.~~

~~This measurement shall be performed at normal and at extreme test conditions (see clauses 5.3 and 5.4).~~

~~The method of measurement shall be documented in the test report.~~

~~7.2.3 Limits~~

~~7.2.3.1 Equipment with fixed beam antenna~~

~~The transmitted power for equipment with fixed beam antennas shall be less than the limits shown in table 1.~~

~~Table 1: Limits for transmitted power (fixed antenna)~~

	~~Class 1~~ ~~(systems others than pulsed Doppler radar)~~	**~~Class 2~~** ~~(pulsed Doppler radar only)~~
~~Mean Power (e.i.r.p.)~~	~~50 dBm~~	~~23,5 dBm~~
~~Peak Power (e.i.r.p.)~~	~~55 dBm~~	~~55 dBm~~

~~Table 2: Limits for transmitted power (steerable antenna)~~

	~~Class 1~~		**~~Class 2~~**	
~~maximum antenna signal dwell time (see note 1)~~	~~t < 100 ms~~	~~t > 100 ms~~	~~t < 100 ms~~	~~t > 100 ms~~
~~Mean Power (e.i.r.p.) (see note 2)~~	~~[55 dBm + 10 log(D)] or 50 dBm (whichever is the smaller)~~	~~50 dBm~~	~~[55 dBm + 10 log(D)] or 23,5 dBm (whichever is the smaller)~~	~~23,5 dBm~~
~~Peak Power (e.i.r.p.)~~	~~55 dBm~~	~~55 dBm~~	~~55 dBm~~	~~55 dBm~~
~~NOTE 1: t is the largest dwell time at any angle.~~ ~~NOTE 2: D is the ratio of the area of the beam (measured at its 3 dB points) to the total area scanned by the antenna. The power is averaged across one antenna cycle. As D is smaller than 1 (i.e. 100 %), the log(D) value is negative and leads to a reduction of the 55 dBm value.~~				

Table 2: Mean power [i.2]

	EUTs others than pulsed radar	**Pulsed radar**
mean power (e.i.r.p.)	50 dBm	23,5 dBm
NOTE: For the purposes of this measurement, the averaging time shall be not greater than 100 ms. If the result varies through the EUT cycle time the maximum value shall be taken as the result.		

~~7.2.3.2 Equipment with (electronically or mechanically) steerable~~For constant pattern scanning antennas

~~The transmitted~~ measured with the scanning inhibited (clause 4.3.5 of ETSI EN 303 396 [1]), the mean power ~~for equipment with steerable antennas~~ shall be ~~less than the limits~~calculated from the measured result $P_{MEASURED}$ as shown in ~~table 2.~~table 3.

Table 3: Mean power calculation (constant pattern scanning antenna)

	EUTs others than pulsed radar		**Pulsed radar**	
Illumination time t (see note 1)	t ≤ 100 ms	t > 100 ms	t ≤ 100 ms	t > 100 ms
mean power (e.i.r.p) (see note 2)	$P_{MEASURED}$ + 10 log(D)	$P_{MEASURED}$	$P_{MEASURED}$ + 10 log(D)	$P_{MEASURED}$
NOTE 1: t is the illumination time defined in ETSI EN 303 396 [1]. NOTE 2: D is the antenna scan duty factor defined in ETSI EN 303 396 [1]. As D is smaller than 1 (i.e. 100 %), the log(D) value is negative and leads to a decrease in the result.				

7.3 Out-of-band emissions

7.3.1 Definitions

Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

Out-of-band emissions are measured as spectral power density under normal operating conditions.

Table 3: Maximum receiver bandwidths

Frequency being measured	Maximum measuring receiver bandwidth
f < 1 000 MHz	100 kHz to 120 kHz
f ≥ 1 000 MHz	1 MHz

74.3.2 Measuring receiver.4 Conformance

The term "measuring receiver" refers to either a selective voltmeter or spectrum analyser. The bandwidth of the measuring receiver shall, where possible, be according to CISPR 16 [The conformance test suite for mean power shall be as defined in clause 6.3.4 of ETSI EN 303 396 [**Error! Reference source not found.**]. In order to obtain the equired sensitivity a narrower bandwidth may be necessary, this

Conformance shall be stated in the established under normal and extreme test report formconditions defined in clause 4.1.

The bandwidth of interpretation of the results for the measurements uncertainty shall be as given in clause 4.6 of ETSI EN 303 396 [1].

4.3.3 Peak Power

4.3.3.1 Applicability

This requirement applies to all EUT.

4.3.3.2 Description

The description in ETSI EN 303 396 [1], clause 6.2.4 applies.

4.3.3.3 Limits

The peak power for EUT with fixed beam or scanning antenna shall not be greater than 55 dBm.

4.3.3.4 Conformance

The conformance test suite for peak power shall be as defined in clause 6.3.3 of ETSI EN 303 396 [1].

Conformance shall be established under normal and extreme test conditions defined in clause 4.1.

The interpretation of the results for the measurements uncertainty shall be as given in clause 4.6 of ETSI EN 303 396 [1].

4.3.4 Unwanted emissions in the out-of-band domain

4.3.4.1 Applicability

This requirement applies to all EUT.

4.3.4.2 Description

The description in ETSI EN 303 396 [1], clause 6.2.11 applies.

4.3.4.3 Limits

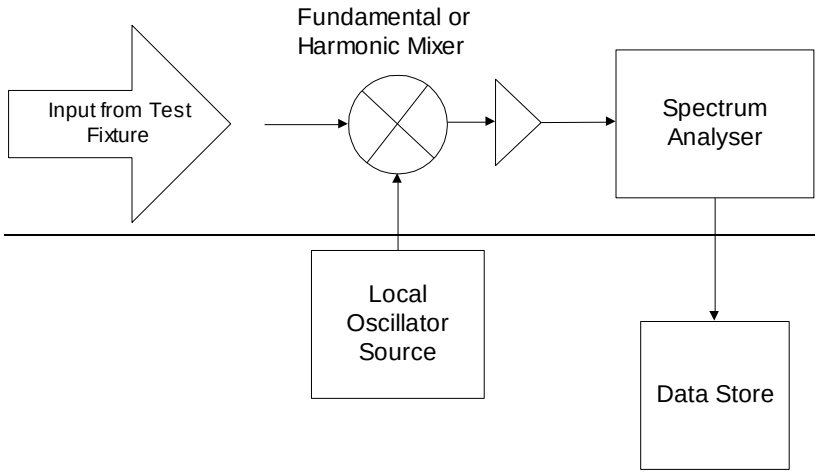
The RMS mean power spectral density radiated in the ~~measuring receiver shall be less~~calculated out-of-band domain (between F_1 to f_L and f_H to F_2 band) shall not be greater than the ~~maximum~~values given in table ~~3~~4.

Table 4: Limits for out-of-band radiation [i.4]

Frequency [GHz]	RMS mean power spectral density [dBm/MHz]
$F_1 \leq f < f_L$	0
$f_H < f \leq F_2$	0

~~7.3.3 Method of measurement~~

~~A test site such as one selected from annex A, which fulfils the requirements of the specified frequency range of this measurement shall be used. The test method employed should be as described in annex B. The bandwidth of the measuring receiver shall be set to a suitable value to correctly measure the unwanted emission. This bandwidth shall be recorded in the test report. For frequencies above 40 GHz a downconverter shall be used as shown in figure 3a. The local oscillator used to downconvert the received signals shall be stable and with a phase noise of better than -80 dBc/Hz at 100 kHz offset. The local oscillator frequency shall be selected such that the downconverted signal is within the accepted band of the spectrum analyser, and maintaining an adequate IF bandwidth to capture the full spectrum of the signal. The e.i.r.p. of the EUT shall be measured and recorded.~~



~~Figure 3a: Test equipment for measuring out of band radiation above 40 GHz~~

~~The spectral density of the signal with normal modulation shall be measured and recorded in frequency bands adjacent to the 76 GHz to 77 GHz band, up to the frequencies where the spectral density is 40 dB below its maximum value.~~

~~7.3.4 Limits~~

~~The mean power density radiated outside the 76 GHz to 77 GHz band shall not exceed the values shown in table 4.~~

~~Table 4: Limits for out of band radiation~~

~~Frequency~~	~~Maximum mean power density (dBm/MHz)~~
~~73,5 GHz to 76 GHz~~	~~0~~
~~77 GHz to 79,5 GHz~~	~~0~~

The values f_L and f_H are the results of the operating frequency range conformance test, see clause 4.3.1.4.

The values F_1 and F_2 are calculated as in ETSI EN 303 396 [1], clause 6.2.11.

NOTE: The out-of-band domain may be larger or smaller than the maximum permitted range of operation.

4.3.4.4 Conformance

The conformance test suite for unwanted emissions in the out-of-band domain shall be as defined in clause 6.3.10 of ETSI EN 303 396 [1].

Conformance shall be established under normal test conditions defined in clause 4.1.

The interpretation of the results for the measurements uncertainty shall be as given in clause 4.6 of ETSI EN 303 396 [1].

4.3.5 Unwanted emissions in the spurious domain

4.3.5.1 Applicability

This requirement applies to all EUT.

4.3.5.2 Description

The description in ETSI EN 303 396 [1], clause 6.2.11 applies.

4.3.5.3 Limits

The effective radiated power of any radiated spurious emission shall be not greater than the values given in table 5.

Table 5: Limits of radiated spurious emissions [i.4]

Frequency range (MHz)	Limit values for spurious radiation	Detector type
47 to 74	-54 dBm e.r.p.	Quasi-Peak
87,5 to 118	-54 dBm e.r.p.	Quasi-Peak
174 to 230	-54 dBm e.r.p.	Quasi-Peak
470 to 790	-54 dBm e.r.p.	Quasi-Peak
otherwise in band 30 to 1 000	-36 dBm e.r.p.	Quasi-Peak
f > 1 000 to 300 000 (see note)	-30 dBm e.i.r.p.	RMS
NOTE: Measurement is only required up to the 2nd harmonic of the fundamental frequency (as defined in CEPT/ERC/REC 74-01 [i.4]). In this case, the upper frequency limit up to which measurements are performed is 154 GHz.		

~~7.4 Radiated spurious~~ .3.5.4 Conformance

The conformance test suite for unwanted emissions in the spurious domain shall be as defined in clause 6.3.10 of ETSI EN 303 396 [1].

~~7.4.1 Definition~~

~~Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.~~

~~Spurious emissions are measured as spectral power density~~Conformance shall be established under normal ~~operating~~test conditions defined in clause 4.1.

~~7.4.2 Measuring receiver~~

~~Refer to clause 7.3.~~The interpretation of the results for the measurements uncertainty shall be as given in clause 4.6 of ETSI EN 303 396 [1].

4.4 Receiver Conformance Requirements

4.4.1 Introduction

ETSI EG 203 336 [i.5] lists candidate technical parameters to be included in a Harmonised Standard aimed at providing a presumption of conformity of radio equipment with the essential requirements in articles 3.1(b) and 3.2 of the Radio Equipment Directive 2014/53/EU [i.3].

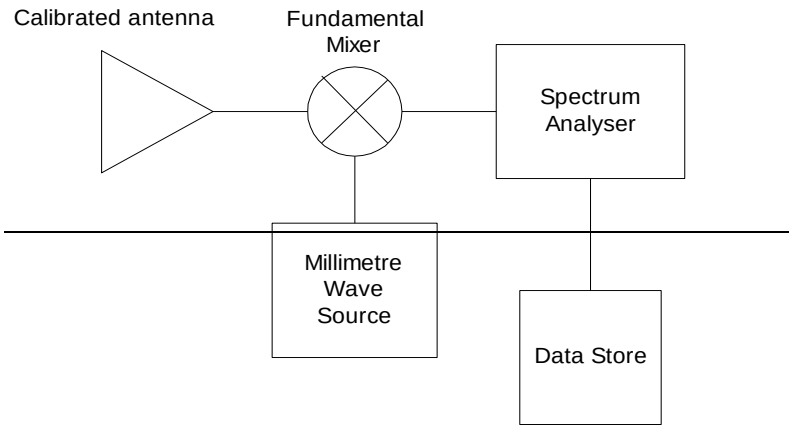
Essential requirements are high level objectives described in European Directives. The purpose of the Harmonised Standard is to translate those high level objectives into detailed technical specifications.

The present document applies to radar systems for which the "classical" receiver parameters are not necessarily relevant. Where applicable, suitable alternative technical requirements are included, see clause 4.4.3.

4.4.2~~.~~

~~7.4.3 Method of measurement for radiated~~ Receiver spurious emissions

~~A test site such as one selected from annex A, which fulfils the requirements of the specified frequency range of this measurement shall be used. The test method employed should be as described in annex B. The bandwidth of the measuring receiver shall be set to a suitable value to correctly measure the spurious or out-of-band emissions. This bandwidth shall be recorded in the test report. For frequencies above 40 GHz a downconverter may be used as shown in figure 4. The local oscillator used to downconvert the received signals shall be stable and with a phase noise of better than -80 dBc/Hz at 100 kHz offset. The local oscillator frequency shall be selected such that the downconverted signal is within the accepted band of the spectrum analyser, and maintaining an adequate Intermediate Frequency (IF) bandwidth to capture the full spectrum of the signal. The e.i.r.p. of the EUT shall be measured and recorded. For these measurements it is strongly recommended to use a LNA (low noise amplifier) before the spectrum analyser input to achieve the required sensitivity.~~



~~Figure 4: Test equipment for measuring~~4.4.2.1 Applicability

Receiver spurious emission testing shall apply for any mode other than transmit mode.

NOTE: Otherwise receiver spurious emissions are measured as part of the transmitter spurious emissions ~~above 40 GHz~~

~~7.~~, see clause 4.4~~3~~.5.

4.4.2.2 Description

The description in ETSI EN 303 396 [1], clause 6.2.12 applies.

4.4.2.3 Limits

The effective radiated power ~~density~~ of any ~~radiated~~narrowband receiver spurious emission shall be not ~~exceed~~greater than the values given in table ~~5 and shall be in accordance to CEPT/ERC/Recommendation 74-01 [8].~~6.

~~Table 5: Limits of radiated spurious emissions~~

~~Frequency range (MHz)~~	~~Limit values for spurious radiation~~
~~47 to 74~~	~~-54 dBm/100 kHz~~
~~87,5 to 118~~	~~-54 dBm/100 kHz~~
~~174 to 230~~	~~-54 dBm/100 kHz~~
~~470 to 862~~	~~-54 dBm/100 kHz~~
~~otherwise in band 30 to 1 000~~	~~-36 dBm/100 kHz~~
~~1 000 to 25 000~~	~~-30 dBm/MHz~~
~~25 000 to 40 000~~	~~-30 dBm/MHz~~
~~40 000 to 100 000 (see note)~~	~~-30 dBm/MHz~~
~~NOTE: Not applicable within the permitted range of frequencies from 76 GHz to 77 GHz and in the out of band region as defined in clause 7.3.4.~~	

Table 6: Narrowband spurious emission limits for receivers [i.4]

Frequency range	Limit	Detector type
30 MHz to 1 GHz	-57 dBm (e.r.p.)	Quasi-Peak
above 1 GHz to 300 GHz (see note)	-47 dBm (e.i.r.p.)	RMS
NOTE: Measurement is only required up to the 2nd harmonic of the fundamental frequency (as defined in CEPT/ERC/REC 74-01 [i.4]). In this case, the upper frequency limit up to which measurements are performed is 154 GHz.		

~~8 Receiver~~

~~8.1 Receiver radiated~~ Wideband receiver spurious emissions

~~8.1.1 Definition~~

~~Spurious radiations from the receiver are components at any frequency radiated by the equipment and its antenna. They are specified as the radiated power of any discrete signal.~~

~~8.1.2 Method of measurement - radiated spurious emissions~~

~~This method of measurement applies to receivers having an integral antenna:~~

~~a)~~ ~~A test site selected from annex A 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 and connected to a measuring receiver. The bandwidth of the measuring receiver shall be adjusted until the sensitivity of the measuring receiver is at least 6 dB below the spurious emission limit given in clause 7.4.4. This bandwidth shall be recorded in the test report.~~

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

~~b)~~ ~~The frequency of the measuring receiver shall be adjusted over the frequency range from 25 MHz up to 100 GHz. The frequency of each spurious component shall be noted. If the test site is disturbed by radiation coming from outside the site, this qualitative search may be performed in a screened room with reduced distance between the transmitter and the test antenna.~~

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

~~d) The receiver shall be rotated up to 360° about a vertical axis, to maximize the received signal.~~

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

~~f) The substitution antenna (see clause A.2.3) shall replace the receiver antenna in the same position and in vertical polarization. It shall be connected to the signal generator.~~

~~g) At each frequency at which a component has been detected, the signal generator, substitution antenna and measuring receiver shall be tuned. The test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the measuring receiver. The level of the signal generator giving the same signal level on the measuring receiver as in step c) shall be noted. This level, after correction due to the gain of the substitution antenna and the cable loss, is the radiated spurious component at this frequency.~~

~~h) The frequency and level of each spurious emission measured and the bandwidth of the measuring receiver shall be recorded in the test report.~~

~~i) Measurements b) to h) shall be repeated with the test antenna oriented in horizontal polarization.~~

~~8.1.3 Limit~~

~~The maximum equivalent isotropically radiated power (max. e.i.r.p.) of any spurious emission outside the permitted range of frequencies shall~~ not ~~exceed 2 nW (≈ -57 dBm) in the frequency range 25 MHz ≤ f ≤ 1 GHz and shall not exceed 20 nW (≈ -47 dBm) on frequencies in the range 1 GHz < f ≤ 73,5 GHz and 79,5 GHz < f ≤ 100 GHz in accordance to CEPT/ERC/Recommendation 74-01 [8].~~

~~9 Measurement uncertainty~~

~~The accumulated measurement uncertainties of the test system in use, for the parameters to be measured, should not exceed those~~greater than the values given in table ~~6 to ensure that the measurements remain within an acceptable standard.~~7.

~~Table 6: Absolute measurement uncertainty~~

~~Parameter~~	~~Uncertainty~~
~~Radio Frequency (out of band)~~	~~$\pm 1 \times 10^{-7}$~~
~~Radiated Emission (valid to 100 GHz)~~	~~±6 dB~~
~~Temperature~~	~~±1 K~~
~~Humidity~~	~~±10 %~~

Table 7: Wideband spurious emission limits for receivers [i.4]

Frequency range	Limit	Detector type
30 MHz to 1 GHz	-47 dBm/MHz (e.r.p.)	Quasi-Peak
above 1 GHz to 300 GHz (see note)	-37 dBm/MHz (e.i.r.p.)	RMS
NOTE: Measurement is only required up to the 2nd harmonic of the fundamental frequency (as defined in CEPT/ERC/REC 74-01 [i.4]). In this case, the upper frequency limit up to which measurements are performed is 154 GHz.		

4.4.2.4 Conformance

The conformance test suite for unwanted receiver spurious emissions shall be as defined in clause 6.3.11 of ETSI EN 303 396 [1].

Conformance shall be established under normal test conditions defined in clause 4.1.

The interpretation of the results ~~recorded in the test report~~ for the measurements uncertainty shall be as given in clause 4.6 of ETSI EN 303 396 [1].

4.4.3 Receiver in-band, out-of-band and remote-band signals handling

4.4.3.1 Applicability

This requirement applies to all EUT.

4.4.3.2 Description

The description in ETSI EN 303 396 [1], clause 6.2.13 applies.

4.4.3.3 Limits

The EUT shall achieve the wanted performance criterion, see clause 4.2.2, in the presence of unwanted signals defined in table 8.

The unwanted signal transmitter shall be able to transmit continuous wave signals at specific frequencies, as described in ~~the present document shall be as follows:~~table 8.

Table 8: Unwanted signal for 76-77 GHz sensors

	In-band signal	OOB signal	Remote-band signal
Frequency	Centre frequency (f_c) of the EUT modulated signal (see clause 4.3.1)	$f = f_c \pm F$	$f = f_c \pm 10 \times F$
Signal level field strength at the EUT	55 mV/m	173 mV/m	173 mV/m
Equivalent EIRP at 10 m	10 dBm	20 dBm	20 dBm
F: permitted frequency bandwidth (1 GHz)			

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

~~a) the value of the measurement uncertainty for the measurement of each parameter shall be separately included in the test report;~~

~~b) the value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 6.~~

~~For the test methods, according to the present document the uncertainty figures shall be calculated according to the methods described in the TR 100 028 [4] and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in case where the distributions characterizing the actual measurement uncertainties are normal (i.e. Gaussian)).~~

~~Table 6 is based on such expansion factors.~~

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

4.4.3.4 Conformance

The conformance test suite for receiver in-band, out-of-band and remote-band signals handling shall be as defined in clause 6.3.12 of ETSI EN 303 396 [1].

Conformance shall be established under normal test conditions defined in clause 4.1.

The interpretation of the results for the measurements uncertainty shall be as given in clause 4.6 of ETSI EN 303 396 [1].

4.4.4 Receiver sensitivity

Receiver sensitivity is not specified in the present document in order to allow manufacturers the freedom to tailor equipment to specific circumstances.

For instance, equipment covered by the present document may be intended to detect a target at maximum range or may be intended to discriminate features such as size, shape or velocity at shorter range. The level of minimum usable signal would be different in each case.

5 General considerations for performing the tests

The provisions of ETSI EN 303 396 [1], clause 4 shall apply except as varied herein.

6 Test setup and procedures

The provisions of ETSI EN 303 396 [1], clause 5 shall apply except as varied herein.

7 Conformance methods of measurement for transmitter and receiver

The provisions of ETSI EN 303 396 [1], clause 6 shall apply except as varied herein.

All measurement results shall be recorded in a test report, see clause 4.7 in ETSI EN 303 396 [1].

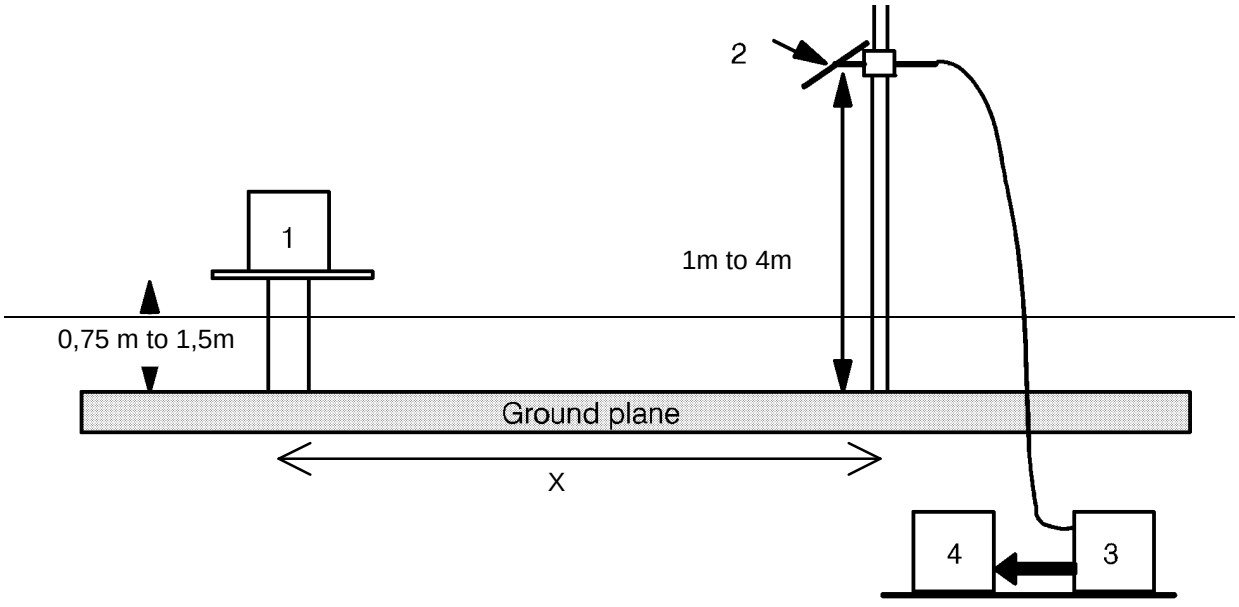
Annex A (normative): Radiated measurements

A.1 Test sites and general arrangements for measurements involving the use of radiated fields

A.1.1 Open Area Test Site (OATS)

The OATS shall be on a reasonably level surface or ground. At one point on the site, an elliptical ground plane conforming to CISPR 16 [3] shall be provided. At one of the foci of this ground plane, a non-conducting support shall be located, capable of rotation in the horizontal and vertical planes, which is used to support the EUT in its standard position, between 0,75 m and 1,5 m above the ground plane. The test antenna shall be sited at the other focus. For measurements below 40 GHz, the test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of $\lambda/2$ or 3 m whichever is greater. For measurements above 40 GHz an anechoic environment should be used, which should be large enough to allow the erection of a test antenna in the far field (i.e. at a distance of not less than $2d^2/\lambda$). The distance actually used shall be recorded with the results of the tests carried out on the site. The suitability of a test site shall be verified by the procedure recommended in CISPR 16 [3] and its amendments where applicable.

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site do not degrade the measurements results.



NOTE 1: Equipment under test.
NOTE 2: Test antenna.
NOTE 3: High pass filter (may not be necessary).
NOTE 4: Spectrum analyser or measuring receiver.

Figure A.1: Measuring arrangement

A.1.2 Test antenna

The test antenna is used to detect the radiation from the EUT, when the site is used for radiation measurements.

This antenna shall be mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarization and for the height of its centre above ground to be varied over the range 1 m to 4 m. A test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20 % of the measuring distance.

For radiation measurements, the test antenna shall be connected to a measuring receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input.

When measuring in the frequency range up to 1 GHz the test antenna shall be a $\lambda/2$ dipole, resonant at the operating frequency, or a shortened dipole, calibrated to the $\lambda/2$ dipole. When measuring in the frequency range above 4 GHz a horn radiator shall be used. For measurements between 1 GHz and 4 GHz either a $\lambda/2$ dipole or a horn radiator may be used.

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

For far field measurements, distance "X" should be a minimum of $2d^2/\lambda$, where d = largest dimension of the antenna aperture of the EUT.

Calibrated test antennae shall be used in all measurements.

The distance between the lower extremity of the test antenna and the ground shall not be less than 0,3 m.

A.1.3 Standard position

The standard position in all test sites, shall be as follows:

- for equipment with integral antenna, it shall be placed in the position closest to normal use as declared by the manufacturer;
- the polarization of the test antenna and the equipment antenna shall be identical within the bandwidth of the equipment antenna; for all other frequencies the test antenna shall be vertically oriented.

A.1.4 Indoor test site

When the frequency of the signals being measured is greater than 80 MHz, use may be made of an indoor site. If this alternative site is used, this shall be recorded in the test report.

Care should be taken as it may not be appropriate to conduct far field measurements above 40 GHz on such a test site.

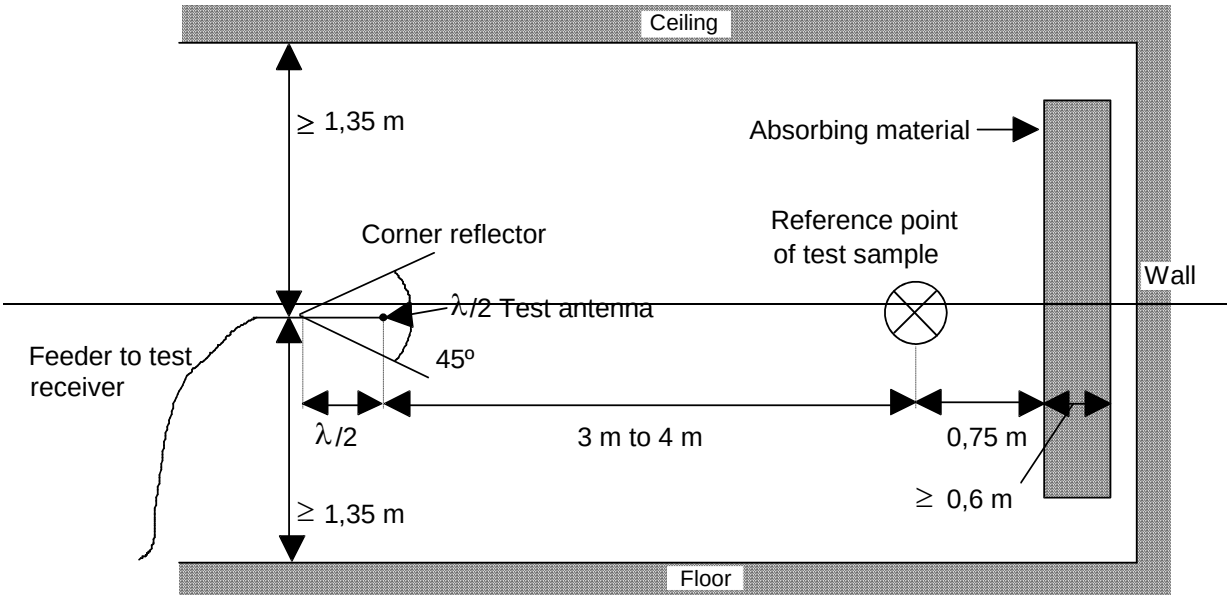
The measurement site shall be a laboratory room with a minimum area of 6 m by 7 m and at least 2,7 m in height.

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

The potential reflections from the wall behind the EUT shall be reduced by placing a barrier of absorbent material in front of it. The corner reflector around the test antenna shall be used to reduce the effect of reflections from the opposite wall and from the floor and ceiling in the case of horizontally polarized measurements.

Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarized measurements. For the lower part of the frequency range (below approximately 175 MHz) no corner reflector or absorbent barrier is needed. For practical reasons, the $\lambda/2$ antenna in figure A.2 may be replaced by an antenna of constant length, provided that this length is between $\lambda/4$ and λ at the frequency of measurement and the sensitivity of the measuring system is sufficient. In the same way the distance of $\lambda/2$ to the apex may be varied.

The test antenna and measuring receiver, are used in a way similar to that of the general method.



~~Figure A.2: Indoor site arrangement (shown for horizontal polarization)~~

~~A.2 Guidance on the use of radiation test sites~~

~~For general guidance on the use of radiation test sites refer to CISPR 16 [3].~~

~~For measurements involving the use of radiated fields, use may be made of a test site in conformity with the requirements of clause A.1. For measurements above 40 GHz care shall be taken to ensure that the selected test site is appropriate. When using such a test site, the following conditions should be observed to ensure consistency of measuring results.~~

~~A.2.1 Measuring distance~~

~~Evidence indicates that the measuring distance is not critical and does not significantly affect the measuring results, provided that the distance is not less than λ/2 at the frequency of measurement and the precautions described in this annex are observed. Measuring distances of 3 m, 5 m, 10 m and 30 m are in common use in European test laboratories.~~

~~A.2.2 Test antenna~~

~~Different types of test antenna may be used, since performing substitution measurements reduces the effect of the errors on the measuring results.~~

~~Height variation of the test antenna over a range of 1 m to 4 m is essential in order to find the point at which the radiation is a maximum.~~

~~Height variation of the test antenna may not be necessary at the lower frequencies below about 100 MHz.~~

A.2.3 Substitution antenna

The substitution antenna and signal generator is used to replace the EUT in substitution measurements. For measurements below 1 GHz the substitution antenna shall be half-wavelength dipole resonant at the frequency under consideration, or a shortened dipole, calibrated to the half-wavelength dipole. For measurements between 1 GHz 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 EUT 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 300 mm.

A.2.4 Auxiliary cables

The position of auxiliary cables (power supply, etc.) which are not adequately decoupled may cause variations in the measuring results. In order to get reproducible results, cables and wires of auxiliaries should be arranged vertically downwards (through a hole in the non conducting support).

A.3 Alternative test site using a fully anechoic RF chamber

For radiation measurements when the frequency of the signals being measured is greater than 30 MHz, use may be made of an indoor site being a well-shielded anechoic chamber simulating free space environment. If such a chamber is used, this shall be recorded in the test report.

The test antenna and measuring receiver, are used in a way similar to that of the general method, clause A.1. In the range between 30 MHz and 100 MHz some additional calibration may be necessary.

An example of a typical measurement site may be an electrically shielded anechoic chamber being 10 m long, 5 m broad and 5 m high. Walls and ceiling should be coated with RF absorbers of 1 m height. The base should be covered with absorbing material 1 m thick, and a wooden floor, able to carry test equipment and operators. A measuring distance of 3 m to 5 m in the long middle axis of the chamber can be used for measurements up to 12,75 GHz. For frequencies above 12,75 GHz the chamber may be used provided it has been calibrated for use at the frequency being measured. The construction of the anechoic chamber is described in the following clauses.

A.3.1 Example of the construction of a shielded anechoic chamber

Free-field measurements can be simulated in a shielded measuring chamber where the walls are coated with RF absorbers. Figure A.3 shows the requirements for shielding loss and wall return loss of such a room. As dimensions and characteristics of usual absorber materials are critical below 100 MHz (height of absorbers < 1 m, reflection and attenuation < 20 dB) such a room is preferably suitable for measurements above 100 MHz. Figure A.4 shows the construction of a shielded measuring chamber having a base area of 5 m by 10 m and a height of 5 m.

Ceilings and walls are coated with pyramidal formed RF absorbers approximately 1 m high or equivalent material with the same performance. The base is covered with absorbers which form a non-conducting sub-floor, or with special ground floor absorbers. The available internal dimensions of the room are 3 m × 8 m × 3 m, so that a measuring distance of maximum 5 m length in the middle axis of this room is available.

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

The floor absorbers reduce floor reflections so that the antenna height need not be changed and floor reflection influences need not be considered.

All measuring results can therefore be checked with simple calculations and the measurement uncertainties have the smallest possible values due to the simple measuring configuration.

A.3.2 Influence of parasitic reflections in anechoic chambers

For free-space propagation in the far field condition the correlation $E = E_0 \cdot (R_0/R)$ is valid for the dependence of the field strength E on the distance R, whereby E_0 is the reference field strength in the reference distance R_0.

It is useful to use just this correlation for comparison measurements, as all constants are eliminated with the ratio and neither cable attenuation nor antenna mismatch or antenna dimensions are of importance.

Deviations from the ideal curve can be seen easily if the logarithm of the above equation is used, because the ideal correlation of field strength and distance can then be shown as a straight line and the deviations occurring in practice are clearly visible. This indirect method shows the disturbances due to reflections more readily and is far less problematical than the direct measurement of reflection attenuation.

With an anechoic chamber of the dimensions suggested in clause A.3 at low frequencies up to 100 MHz there are no far field conditions, and therefore 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 on the distance meets the expectations very well. In the frequency range of 1 GHz to 100 GHz, because more rejections will occur, the dependence of the field strength on the distance will not correlate so closely.

A.3.3 Calibration of the shielded RF anechoic chamber

Calibration of the chamber shall be performed over the range 30 MHz to 100 GHz.

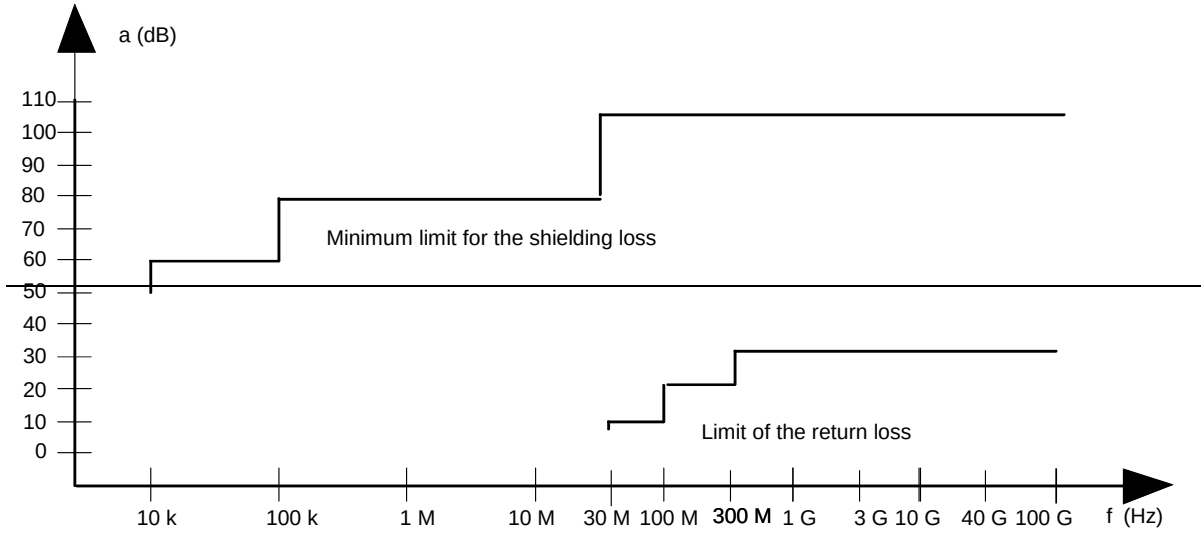
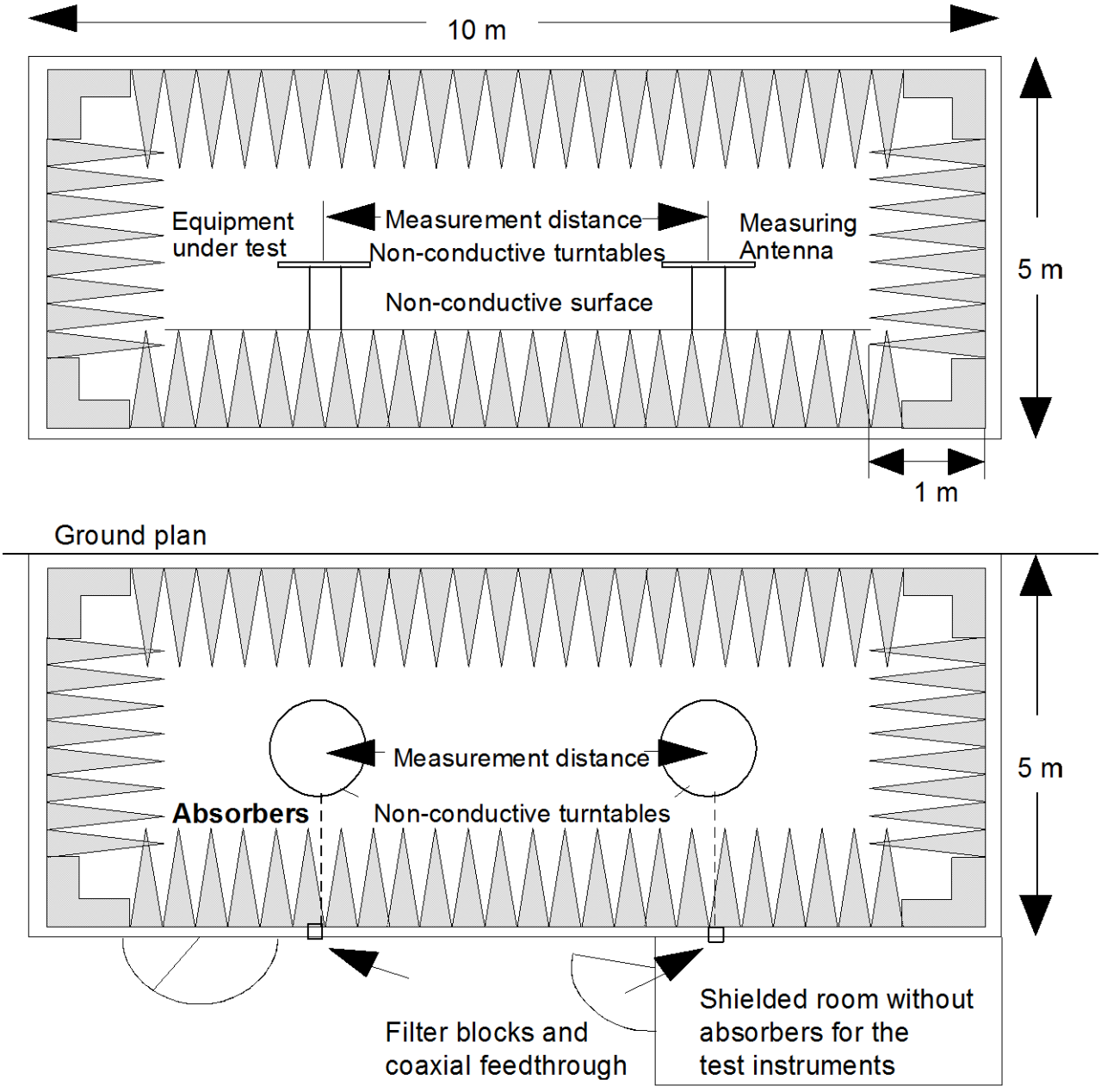


Figure A.3: Specification for shielding and reflections



~~Figure A.4: Example of construction of an anechoic shielded chamber~~

Annex B (normative): General description of measurement methods

B.1 Radiated measurements

Radiated measurements shall be performed with the aid of a test antenna and measuring receiver as described in annex A. The test antenna and measurement receiver, spectrum analyser or selective voltmeter (including all cables) shall be calibrated according to the procedure defined in this annex. The EUT 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.

For equipment with multiple fixed beam antennas, the tests shall be carried out with the test antenna oriented to obtain the maximum emitted power level, and repeated for each beam position. If the equipment transmits more than one beam at a time, then the maximum e.i.r.p. shall be recorded.

If the equipment has an antenna which is either mechanically or electronically scanned, then the scanning shall be inhibited for these tests. With the scanning stopped, the e.i.r.p. for the EUT shall be measured with the antenna in its position of highest gain (i.e. highest output power) as stated by the provider.

Measurements of absolute power levels below 40 GHz shall be carried out at a distance of $\lambda/2$ or 3 m, whichever is greater. For measurements of absolute power above 40 GHz an anechoic environment or test site is necessary which should be large enough to allow the erection of a test antenna in the far field (i.e. at a distance of not less than $2d^2/\lambda$).

Radiated measurements should be performed either with the EUT in the approved test fixture in an anechoic environment, or using the OATS as described in annex A.

The following conditions shall be fulfilled if an OATS is used for measurements:

a) an OATS which fulfils the requirements of the specified frequency range of this measurement (CISPR 16 [3]) shall be used;

b) the EUT shall be placed on the support in its standard position (see clause A.1.3) and switched on;

c) the test antenna shall be oriented initially for vertical polarization unless otherwise stated. The test antenna shall be raised or lowered, through the specified height range until the maximum level is detected on the measuring receiver;

d) the EUT shall be capable of rotation through 360° about a vertical axis to maximize the received signal;

e) 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.

f) this measurement shall be repeated for horizontal polarization;

g) the substitution (calibrated) antenna shall replace the EUT, in the same position and in vertical polarization. The frequency of the signal generator shall be adjusted to the Tx (carrier) frequency;

h) steps c) to f) shall be repeated as necessary;

i) the input signal to the substitution (calibrated) antenna shall be adjusted in level via a calibrated attenuator/signal generator until an equal or a known related level to that detected from the Tx is obtained in the test receiver;

j) this measurement shall be repeated with horizontal polarization;

k) the radiated power is equal to the power supplied by the signal generator, increased by the gain of the substitution antenna and the cable losses between the signal generator and the substitution antenna.

~~If an anechoic chamber is used as opposed to an OATS, the following change to this procedure applies:~~

- ~~the test antenna shall be oriented initially for vertical polarization unless otherwise stated.~~

Annex C (informative): Examples of modulation schemes

C.1 Pulse modulation

C.1.1 Definition

For pulse modulation, the Tx "amplitude" is periodically switched on for a short time (called pulse duration) and switched off during the subsequent reception period. A typical example is shown in figure C.1.

The time between the rising edges of the pulsed output power is called the Pulse Repetition Interval (PRI). The PRI may vary between subsequent pulses, in which case the modulation is called staggered PRI.

The Pulse Repetition Frequency (PRF) is the inverse of the PRI averaged over a time sufficiently long to cover all PRI variations.

The duty cycle is the product of the PRF and the pulse duration.

The radiated power averaged over the pulse duration is called the peak output power.

The peak output power multiplied by the average duty cycle is called the average output power.

Subsequent pulses may be on different frequencies (i.e. stepped frequency).

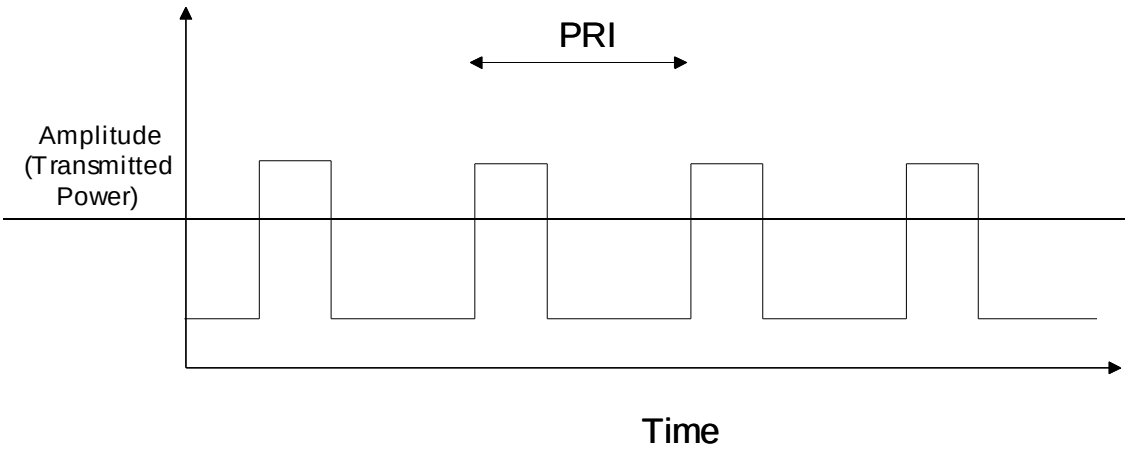


Figure C.1: Typical pulse modulation scheme

C.1.2 Typical operating parameters

The peak and average (RMS) power limits are given in clause 7.2.3. Typical operating parameters are given in table C.1.

Table C.1: Typical operating parameters for pulse modulation

Parameter	Typical value
PRF	1 MHz
PRI	1 µs
Pulse length	15 ns
Frequency step	100 MHz/ns
Duty cycle	< 10 %

C.2 Frequency modulated continuous wave

C.2.1 Definition

For Frequency Modulated Continuous Wave (FMCW) modulation, the transmitted waveform is frequency modulated over a period of time (P). This period of time may be constant, or may be varied. An example of a typical modulation scheme is shown in figure C.2. During the time (P), the frequency may either increase or decrease. The modulation may assume (but is not limited to) the form of a "saw tooth", "triangular" or a "sinusoidal" waveform. Also a constant frequency may be maintained and transmitted during one or more periods of time. Furthermore, the transmitted power may be switched off during one or more periods of time (e.g. Frequency Modulated Interrupted Continuous Wave (FMICW)). The modulation waveform may be repeated or varied over several periods of time, and at the beginning or end of each period of time (P), there may be a time "G" (the "blanking period") where the transmitted waveform is adjusting to the requirements of the beginning of the next period.

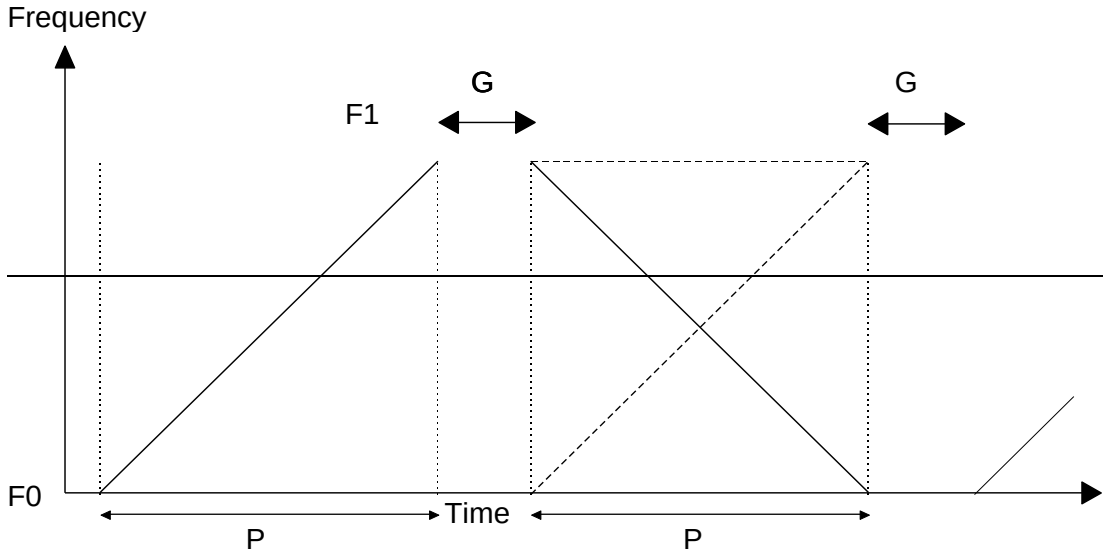


Figure C.2: Typical FMCW modulation scheme

C.2.2 Typical operating parameters

The peak and average (RMS) power limits are given in clause 7.2.3. Typical operating parameters are given in table C.2.

Table C.2: Typical operating parameters for FMCW

Parameter	Typical value
Frequency deviation in one period	150 MHz
Modulation period (P)	10 ms
Blanking period (G)	1 ms
Number of different frequency slopes	3

C.3 Frequency Shift Keying (FSK)

C.3.1 Definition

With typical FSK modulation, an interleaved continuous FSK waveform is transmitted according to a pattern during a period of time known as a frame. During each frequency step the transmitted signal has a constant frequency.

One example of a generic modulation scheme is characterized by the parameters shown in figures C.3 and C.4. In this example, during one frame the sequence of transmitted frequencies are:

f01, f02, ….. f0j, ……. f0p, f11, f12, …… f1j, …. f1p, ….. fn1, fn2, …… fnj, ….. fnp.

Where:

- p is the number of interleaved FSK waveforms
- n + 1 is the number of steps per FSK waveform f_{aj} and $f_{(a+1)j}$ are sequential steps in the waveform identified by the "j" index

Where:

- Δf_j is the frequency deviation step of the waveform identified by the "j" index

With:

- τ = frequency step duration
- ΔF_{max} = maximum frequency deviation of one stepped frequency waveform
- T = frame repetition period (constant)

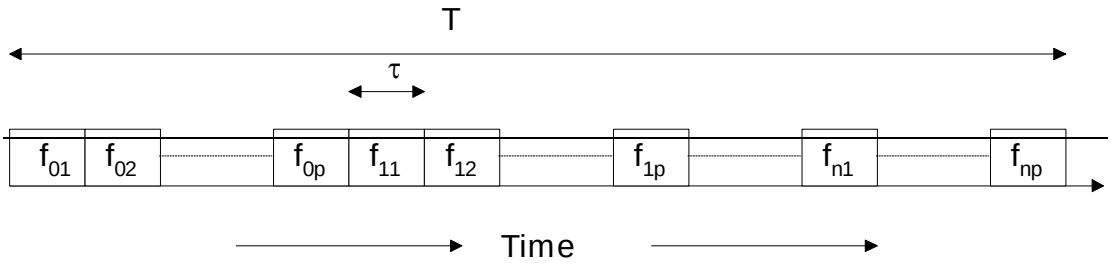


Figure C.3: Typical FSK modulation scheme

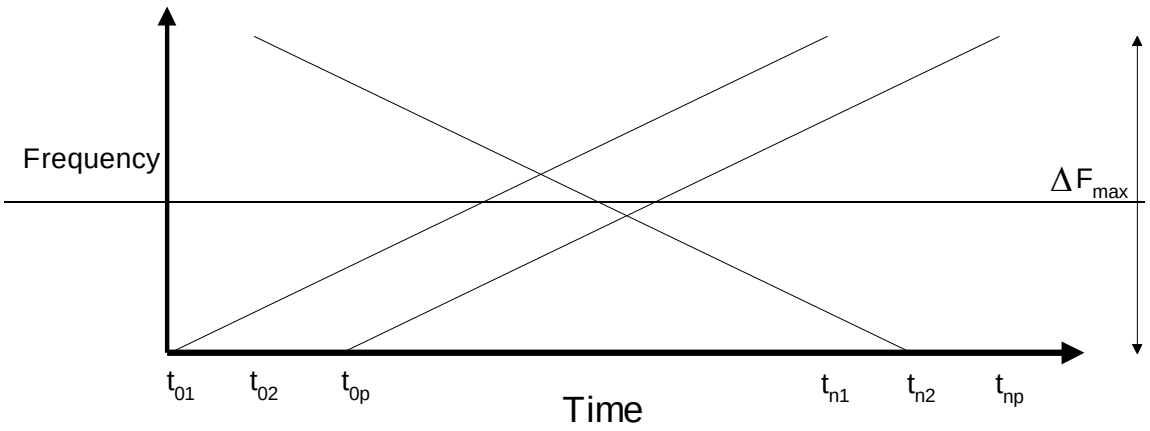


Figure C.4: Typical FSK modulation sequence

C.3.2 Typical operating parameters

The peak and average (RMS) power limits are given in clause 7.2.3. Typical operating parameters are given in table C.3.

Table C.3: Typical operating parameters for FSK modulation

Parameter	Typical value
τ	5 µs
ΔFmax	150 MHz
T	7 ms
n	511
P	3
(Δfj/T) max	100 MHz/µs

C.4 PN-ASK (Pseudo-Noise Amplitude Shift Keying) 77 GHz

C.4.1 Definition

For PN-ASK modulation, the transmitted wave radiation is modulated in amplitude by a pseudo noise code, i.e. the Direct Sequence Signal (DSS), that represents the states of the base band signal of an ASK modulation.

A generic binary DSS impulse $c(t)$ (red) and the corresponding transmitted signal $s(t)$ (blue) are shown in figure C.5. The binary DSS impulse $c(t)$ and the transmitted signal $s(t)$ can be expressed as:

$$c(t) = \sum_{i=0}^{L-1} C_i \times u(t - i \times T_c)$$

$$s(t) = c(t) \times \sin(2\pi \times f_T \times t)$$

Where:

- C_i defines the states {0, +1} of the elementary signals (chips)
- $u(t)$ defines the rectangular signal: $u(t) = \begin{cases} 1 & for\ 0 \le t < T_c \\ 0 & else \end{cases}$
- f_T defines the carrier frequency
- T_c defines the duration of a chip (chip period)
- L defines number of chips per PN-sequence

The bandwidth (B) of the transmitted signal $s(t)$ is defined by the bandwidth of the main lobe and corresponds to twice the inverse of the chip rate, from null to null:

$$B = 2 \times \frac{1}{T_c}$$

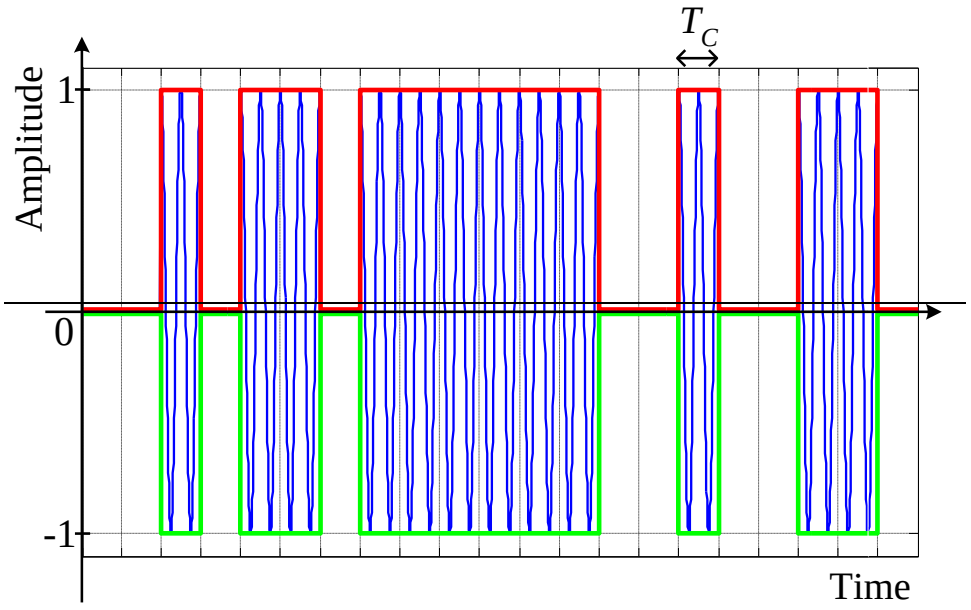


Figure C.5: Typical PN-ASK modulation scheme

C.4.2 Typical operating parameters

The peak and average (RMS) power limits are given in clause 7.2.3. Typical operating parameters are given in table C.4.

Table C.4: Typical operating parameters for PN-ASK Modulation

Parameter	Minimum
Chip period T_c	2 ns
PN-sequence period ($L \times T_c$)	10 µs
Occupied bandwidth B ($DSB_{-10\ dB}$)	1 GHz

Annex D (informative): Conversion of power density to e.i.r.p.

This annex offers an example of the conversion from "power/unit area" (power density) to e.i.r.p.

D.1 Assumptions

e.i.r.p. is the product of "power into the antenna" multiplied by the "antenna gain".

e.i.r.p. is the total power transmitted, assuming an isotropic radiator.

Area of a sphere = πd^2.

D.2 Example

For a power density of 200 nW/cm^2 (measured at 3 m):

200 nW/cm² (at 3 m) = power measured in a 1 cm^2 area at 3 m distance.

e.i.r.p. = total radiated power over the whole area of a sphere.

e.i.r.p. = [power measured in a 1 cm^2 area at 3 m distance (W)] × [area of sphere at 3 m (in cm^2)].

e.i.r.p. = $[(200 \times 10^{-9}) \times (\pi \times 36 \times 10^4)]$ W.

e.i.r.p. = 226,19 mW.

Hence: = 200 nW/cm^2 (at 3 m) = 23,54 dBm.

~~Annex E (informative): Bibliography~~

~~ETSI EN 301 489-3 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz".~~

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.6] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.3].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

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

Harmonised Standard ETSI EN 301 091-1				
Requirement			Requirement Conditionality	
No	Description	Reference: Clause No	U/C	Condition
1	Operating Frequency Range	4.3.1	U	
2	Mean Power	4.3.2	U	
3	Peak Power	4.3.3	U	
4	Unwanted emissions in the out-of-band domain	4.3.4	U	
5	Unwanted emissions in the spurious domain	4.3.5	U	
6	Receiver spurious emissions	4.4.2	C	It applies for any mode other than transmit mode.
7	Receiver in-band, out-of-band and remote-band signal handling	4.4.3	U	

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (informative): Change History

Version	Information about changes
1.3.3 (part 1) 1.3.2 (part 2)	Last publication as two-part HS
2.1.1	• Revision for compliance with Directive 2014/53/EU • The EN was split into a 3 part document (all parts harmonised) – Part 1: ground based vehicle – Part 2: fixed TTT applications – Part 3: railway/road crossing • Out-sourcing of standard measurement procedures into a separate ETSI EN 303 396 • More detailed description of receiver spurious emission requirements • New requirement on receiver in-band, out-of-band and remote-band handling and method of measurement

History

Document history		
V1.1.1	June 1998	Publication as ETSI EN 301 091
V1.2.1	November 2004	Publication
~~V1.3.2~~	~~May 2006~~	~~One-step Approval Procedure OAP 20060922: 2006-05-24 to 2006-09-22~~
V1.3.3	November 2006	Publication
V2.1.0	April 2016	EN Approval Procedure AP 20160717: 2016-04-18 to 2016-07-18
V2.1.1	November 2016	Vote V 20170122: 2016-11-23 to 2017-01-23
V2.1.1	January 2017	Publication