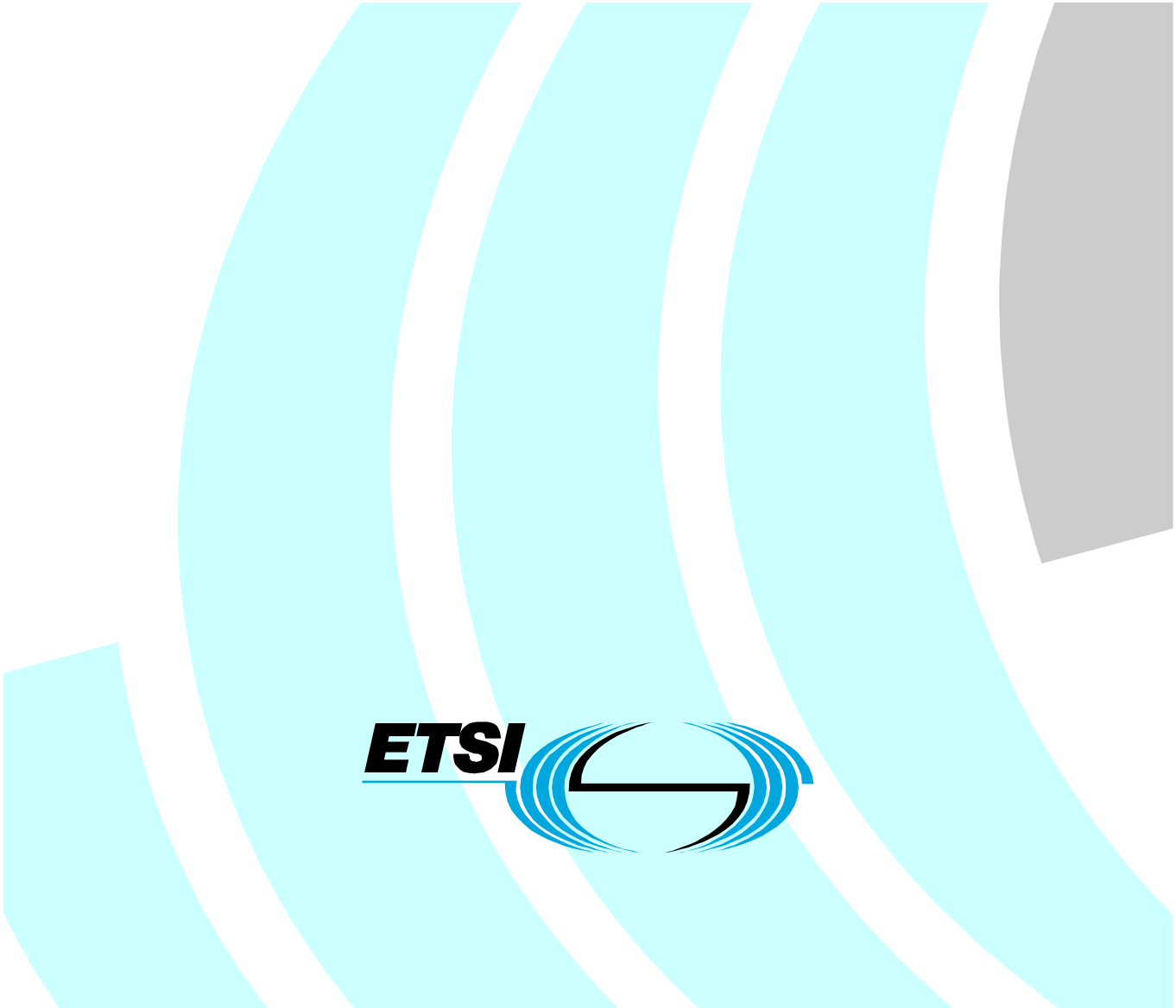
ETSI TS 102 329 V1.2.1 (2007-06)

Technical Specification

Fixed Radio Systems;
Point-to-Point equipment;
Radio equipment and antennas for use in Point-to-Point High Density applications in the Fixed Services (HDFS) frequency band 64 GHz to 66 GHz



Reference
RTS/TM-04165

Keywords
antenna, DFRS, FWA, point-to-point, radio, transmission

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

Introduction

Currently, all standardized point-to-point systems, in bands between 1 GHz and 58 GHz, have been combined into a single multi-part standard, EN 302 217 (see Bibliography), which includes Harmonized parts 2-2, 3 and 4-2 that are relevant to article 3.2 of the Directive 1999/05/EC [1] (R&TTE Directive).

The technical specifications of High Density applications in the Fixed Service (HDFS) and suitable Antenna systems in the band 64 GHz to 66 GHz are described in the present document.

NOTE: The present document intends to fill the vacancy, in this band, of standardized parameters for P-P systems, which, suitably analysed and refined, should be converted into a revision of EN 302 217-3 [12]. In that case, the provision of EN 302 217-3 [12] will take precedence over the present document.

1 Scope

The present document applies to High Density applications in the Fixed Service (HDFS) in the band 64 GHz to 66 GHz.

Radio frequency propagation in the band 64 GHz to 66 GHz is subject to high levels of oxygen absorption. For this reason this band is suited to short-range applications and permits a very high re-use factor. An additional advantage is the high directivity of the pencil-formed beam of the antenna. The typical range of applications may vary from narrow band utilization to very wide-band short connections using different spectral efficiency classes. Therefore no limitation provided is here made for occupied bandwidth provided that it remains with in 64 GHz to 66 GHz band, as well as no guideline for frequency-division duplex or time-division duplex.

For the purpose of the present document, a planning assumption is made that the system operates within a "Technology-independent assignment" of any size up to 2 GHz; therefore, it includes those system characteristics that, according to the related planning assumptions, may be considered relevant to essential parameters under article 3.2 of the Directive1999/5/EC [1].

The technical specification falls into two different categories concerning the frequency arrangement derived from the Recommendation ECC/REC(05)02 [8] which has some effect on the requirements to the radio equipment. For both categories the appropriate parameters as transmitter characteristics and receiver requirements are described separately

They are listed in the appropriate clause.

The two categories of equipment are fitted for different frequency arrangements possibly established in the band:

- **Category 1**: Equipment for a flexible usage of spectrum; where no channel or block arrangement is to be complied with. The used transmitter bandwidth is referred to the occupied bandwidth as defined within this technical specification. The present document provides Category 1 differentiated requirements only for equipment of spectral efficiency classes 1 and 2 as defined below. Administrations may require specific measures to avoid interference e.g. listen-before talk.
- **Category 2**: Equipment suitable also for a fixed frequency arrangements; where one or more 30 MHz frequency slots are assigned/notified to form a channel or a block. Category 2 conformance automatically implies conformance also to Category 1 requirements.

As the maximum transmission rate in a given bandwidth depends on system spectral efficiency, different equipment classes are defined:

Class 1: equipment spectral efficiency based on typically 2-states modulation scheme (e.g. 2-FSK, or equivalent);

Class 2: equipment spectral efficiency based on typically 4-states modulation scheme (e.g. 4-FSK, 4-QAM, or equivalent);

Class 3: equipment spectral efficiency based on typically 8-states modulation scheme (e.g. 8-PSK, or equivalent);

Class 4: equipment spectral efficiency based on typically 16 or 32-states modulation scheme (e.g. 16-QAM, 32-QAM, or equivalent);

Class 5: equipment spectral efficiency based on typically 64 or 128-states modulation scheme (e.g. 64-QAM, 128-QAM, or equivalent).

The above classes are indicative only and do not imply any constraint to the actual modulation format, provided that all the requirements in the present document are met.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest 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.

[1] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

[2] ETSI EN 301 126-1: "Fixed Radio Systems; Conformance testing; Part 1: Point-to-point equipment - Definitions, general requirements and test procedures".

[3] ETSI EN 301 126-3-1: "Fixed Radio Systems; Conformance testing; Part 3-1: Point-to-Point antennas; Definitions, general requirements and test procedures".

[4] CEPT/ERC Recommendation 74-01: "Spurious Emissions".

[5] ITU-R Recommendation SM.1045: "Frequency tolerance of transmitters".

[6] ETSI EN 301 390: "Fixed Radio Systems; Point-to-point and Multipoint Systems; Spurious emissions and receiver immunity limits at equipment/antenna port of Digital Fixed Radio Systems".

[7] ITU Radio Regulations.

[8] ECC/Recommendation (05)02: "Use of the 64 - 66 GHz frequency band for the fixed service".

[9] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".

[10] ETSI EN 301 489-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services".

[11] ETSI EN 300 019 (all parts): "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[12] ETSI EN 302 217-3: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for equipment operating in frequency bands where no frequency co-ordination is applied".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

allocated radio frequency band: entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specific conditions

NOTE: This term is also to be applied to the frequency band concerned (RR article 1, No. 17 of ITU Radio Regulations [7]).

Automatic Transmit Power Control (ATPC): function implemented to offer a dynamic power control that delivers maximum power only during deep fading; in this way for most of the time the interference is reduced and the transmitter operates in a higher linearity mode

NOTE 1: When this function is used, the transmit power is dynamically changed with respect to the propagation conditions. In principle, when ATPC is implemented, three different level of power may be identified:

- **maximum available power** (delivered only in conditions of deep fading);
- **maximum nominal power** (useable on a permanent basis when ATPC is disabled); it should be noted that this power is "nominal for the equipment" and is not to be confused with the "nominal level set link by link" by the frequency co-ordinating body. This is achieved through passive RF attenuators or use of the RTPC function;
- **minimum power** (delivered in unfaded conditions).

NOTE 2: Maximum nominal and maximum available power levels may be coincident or, in case of multi-state modulation formats, the maximum available power may be used to overdrive the transmitter (loosing linearity but gaining fade margin when the fade conditions have already impaired the expected RBER). Performance prediction are usually made with the maximum "available power".

block assignment: application of block of spectrum assigned to one or more stations of an operator under a single exclusive licence

channel bandwidth: sum of the minimum number of 30 MHz slots that contain the occupied bandwidth of the emission

channel separation: defined as the radio-frequency separation between the centre frequencies of adjacent radio-frequency channels on the same polarization and in the same direction of the transmission. The channel separation is also considered to be equal to the channel bandwidth

conformity assessment procedure: See Directive 1999/5/EC [1] annexes II, III, IV and V.

environmental profile: range of environmental conditions under which equipment, within the scope of the present document, is required to comply with the relevant provisions

essential phenomenon: radio frequency phenomenon related to the essential requirements under article 3.2 of the Directive 1999/5/EC [1] that is capable of expression in terms of quantifiable technical parameters

frequency slot: basis on which one or more slots can be aggregated to form a channel or a block

occupied bandwidth: width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission

NOTE: For the purpose of the present document, $\beta/2$ is to be equal to 0,5 %.

operating frequency range: range(s) of radio frequency channels covered by the Equipment Under Test (EUT) without any change

radio equipment: a product or relevant component thereof capable of communication by means of the emission and/or reception of radio waves utilizing the spectrum allocated to terrestrial/space radio communication

NOTE: See article 2 of Directive 1999/5/EC [1].

Remote Transmit Power Control (RTPC): many fixed digital radio systems offer this functionality as a qualifying aid to the deployment

NOTE: When this function is used, the transmit power can be set either by a local control unit, connected to the system control unit, or by a remote network management terminal. The power variation is static and usually made at the activation or re-commissioning of links in order to easily obtain the EIRP required by the frequency co-ordinating body for that link, to control co-channel and adjacent channel interference in the same geographical area. In principle, this function is equivalent to the requirement power regulation capability (e.g. by fixed attenuators) commonly required in fixed systems.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

dB	decibel
dBm	decibel ratio relative to 1 milliWatt
dBW/MHz	spectral power density relative to 1 Watt in 1 MHz bandwidth
GHz	GigaHertz
Mbit/s	Mega-bits per second
MHz	MegaHertz
ppm	parts per million

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
CW	Continuous Wave
DFRS	Digital Fixed Radio Systems
EIRP	Equivalent Isotropically Radiated Power
FDD	Frequency Division Duplex
FER	Frame Error Ratio
HDFS	High Density applications in the Fixed Service
OOK	On-Off Keying

NOTE: Also referred to as Binary Amplitude keying.

PFD	Power Flux Density
R&TTE	Radio equipment and Telecommunications Terminal Equipment Directive
RF	Radio Frequency
RFC	Remote Frequency Control
RIC	Radio Interference Capacity
RPE	Radiation Pattern Envelope
RSL	Receive Signal Level
RTPC	Remote Transmit Power Control
TDD	Time Division Duplex
Tx	Transmitter

4 System requirements

The following clauses describe the requirements that have been considered necessary for the deployment of systems with the planning assumptions in the scope of the present document. They may be used, by equipment suppliers in agreement with a Notified Body, as reference for the phenomena relevant to essential requirements under article 3.2 of Directive 1999/5/EC [1].

NOTE: Test methods referenced below are only those considered essential for the possible assessment of conformity to article 3.2 (i.e. for the reproducibility of the results).

4.1 Phenomena description

Guidance and description of the phenomena relevant to "essential requirements" under article 3.2 is given in EG 201 399 (see bibliography); specific applications and descriptions for DFRS is given in TR 101 506 (see bibliography).

4.2 Environmental specifications and tests

The technical requirements of the present document apply under the environmental profile for intended operation of the equipment and or antennas, which shall be declared by the manufacturer or person responsible for placing the apparatus on the market.

The environmental profile may be determined by the environmental class of the equipment and antennas according to the guidance given in clause 4.4 of EN 301 126-1 [2].

The environmental profile of the equipment and antennas shall be declared by the manufacturer or person responsible for placing the apparatus on the market.

The equipment and antennas shall comply with all of the requirements of the present document at all times, when operating within the boundary limits of the required declared operational environmental profile.

Any test carried out with the intention of generating a test report and/or declaration of conformity, required to fulfil any conformity assessment procedure foreseen by the R&TTE Directive [1] for radio equipment, shall be carried out with the same principles and procedures for both reference and extreme conditions reported in clause 4.4 of EN 301 126-1 [2]. The requirement for testing at reference or extreme conditions is reported in any relevant clauses of the present document, according to the principles for similar requirements in EN 301 126-1 [2].

Any test carried out with the intention of generating a test report and/or declaration of conformity, required to fulfil any conformity assessment procedure foreseen by the R&TTE Directive 1999/5/EC [1] for integral or stand-alone antennas, shall be carried out with the same principles and procedures for both reference and extreme conditions reported in clause 4.4 of EN 301 126–1 [2]. The requirement for testing at reference or extreme conditions is reported in any relevant clauses of the present document, according to the principles for similar requirements in EN 301 126-1 [2].

The test report shall be produced according to the procedure foreseen by article 10 of the Directive 1999/5/EC [1].

4.3 Radio-frequency range for which specifications and tests are applicable

4.3.1 Radio equipment

Equipment can provide single radio frequency operation (e.g. when RF duplexer filters are tuned to a specific operating frequency) or offer a wider operating frequency range (e.g. wide-band RF duplexer and frequency agility through the use of an RFC function). Ease of deployment and spare parts handling by operators with large networks is facilitated where more than one frequency is used.

The equipment shall comply with all the requirements of the present document at any possible operating frequency. The transmitter bandwidths of equipment are not specified. This aspect may enable manufacturers to build equipment to any bandwidth, from a frequency slot of 30 MHz up to 2 GHz.

The tests shall be carried out in the following way:

1) in the case of equipment intended for single frequency operation, the test report shall be produced for a single operating radio frequency arbitrarily chosen by the supplier (see figure 1);

2) in the case of equipment intended for covering an operating frequency range, the test report shall be produced for the lowest, central (intermediate) and highest possible operating radio frequencies within that operating frequency range (see figure 1);

NOTE: Figure 1 refers to FDD applications. When TDD is used the option to use the higher and lower sub-band concept does not apply.

3) it is not required that all the tests, required for the test report, are made on the same sample of equipment and at the same time; provided that the test report includes all of the tests required by the present document, each test may be made on different samples of the same equipment, at different operating frequencies or frequency ranges and at different times.

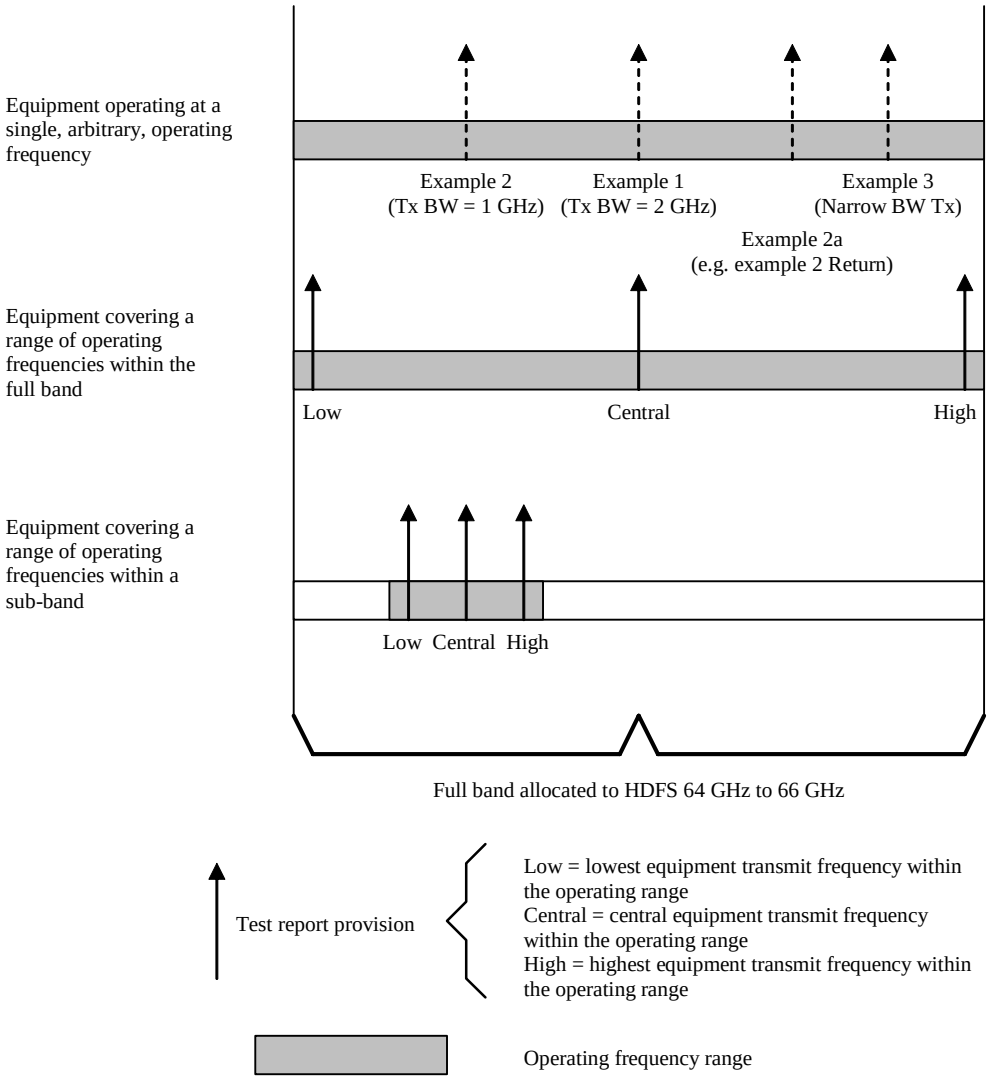


Figure 1: Test report frequency requirements for equipment intended to cover a single frequency or range of operating frequencies within 64 GHz to 66 GHz

4.3.2 Antennas for applications in the fixed service

Commonly, antennas cover an operating frequency range declared by the supplier. The antenna parameters shall comply with all the requirements of the present document within the declared operating frequency range. The tests shall be carried out at the lowest, middle and highest frequency of the relevant frequency range to produce the test report and/or declaration of conformity required (Directive 1999/5/EC [1]).

Furthermore, the tests shall be carried out according to clause 4 of EN 301 126-3-1 [3].

4.4 Spectrum efficiency and channel arrangements

The frequency range, within which occupied bandwidth shall be contained, is 64 GHz to 66 GHz.

ECC/REC (05)02 [8] provides for two different frequency arrangements:

- Frequency use without specific channel or block arrangements (flexible usage of spectrum).
- Frequency arrangements with co-polar channel or block assignments based on 30 MHz elementary slots aggregation.

Minimum spectrum efficiency (see note) and their correlated equipment class in the present document are reported in table 1.

NOTE: Spectral efficiency is defined as the ratio between the peak gross bit rate and the Occupied Bandwidth (for Category 1 systems) or the Channel Bandwidth (for Category 2 systems).

Table 1: Minimum spectral efficiency

Equipment spectral efficiency Class	**1**	**2**	**3**	**4**	**5**
Minimum spectral efficiency (bit/s/Hz)	0,5	1	1,6	2,2	4
NOTE: Category 1 systems are limited to classes 1 and 2 only.					

4.5 Environmental conditions

The equipment shall be required to meet the environmental conditions set out in EN 300 019 [11], which defines weather protected and outdoor environmental Classes and test severities. The manufacturer shall state which class the equipment is designed to withstand.

4.6 ElectroMagnetic Compatibility

Equipment shall operate under the conditions specified in EN 301 489-1 [9] and EN 301 489-4 [10].

4.7 Baseband interface

The manufacturer shall declare whether a standard interface is provided or not. Standardized interfaces are referred in EN 302 217-3 [12].

4.8 Transmitter requirements

The specified transmitter characteristics shall be met with the appropriate base band signals applied at one of the reference points X' of figure B.1.

4.8.1 Radio frequency tolerance

For category 1equipment the maximum radio frequency tolerance shall not exceed ±150 ppm
(see ITU-R Recommendation SM.1045 [5]) for operation in the environmental profile declared by the supplier.

For category 2 equipment the maximum radio frequency tolerance shall not exceed ±50 ppm for operation in the environmental profile declared by the supplier.

The limits include both short-term factors (e.g. environmental effects) and long term factors (e.g. ageing effects).

Tests shall be carried out at reference and extreme climatic conditions according to clause 4.4 of EN 301 126-1 [2] to produce the test report and/or declaration of conformity required (Directive 1999/5/EC [1]).

4.8.2 Transmitter emission limits

4.8.2.1 Maximum EIRP

The maximum EIRP, including any tolerance, shall be equal to +33 dBW. The test can be carried out, whenever possible, with separate tests for equipment output power and antenna gain.

NOTE: Testing EIRP requirements is necessary for assessment of equipment with integral antenna only; however, equipment placed on the market without antennas should, in principle, refer, when relevant in common practice, to such limitation (e.g. defining the maximum associated antenna gain).

For equipment with integral antenna, the test methods for the EIRP may be derived from the gain measurement in clause 6.3 of EN 301 126-3-1 [3].

The tests shall be carried out at reference and extreme climatic conditions according to clause 4.4 of EN 301 126-1 [2] to produce the test report and/or declaration of conformity required (Directive 1999/5/EC [1]).

4.8.2.2 EIRP Spectrum density mask

The maximum power shall be limited, in terms of the power EIRP of the systems, to within the EIRP spectral density mask shown below. Those limits shall be inclusive of tolerances and, if applicable, ATPC/RTPC influence. For equipment designed for specific channel or block assignment the channel and duplex separation are defined only according the required radio frequency arrangements (e.g. according annex 3 of ECC/REC(05)02 [8].

The tests shall be carried out at reference and extreme climatic conditions according to clause 4.4 of EN 301 126-1 [2] to produce the test report and/or declaration of conformity required (Directive 1999/5/EC [1]).

However, it is recommended that the manufacturer or person responsible for placing the apparatus on the market shall provide the transmit mask characteristics met by the equipment. Also, in order to assist administrations and operators in the planning of networks, where appropriate, the duplex arrangement (Go/Return separation) should be provided for category 1 equipment. For category 2 equipment the channel and duplex separation are given by annex 3 of ECC/REC(05)02 [8].

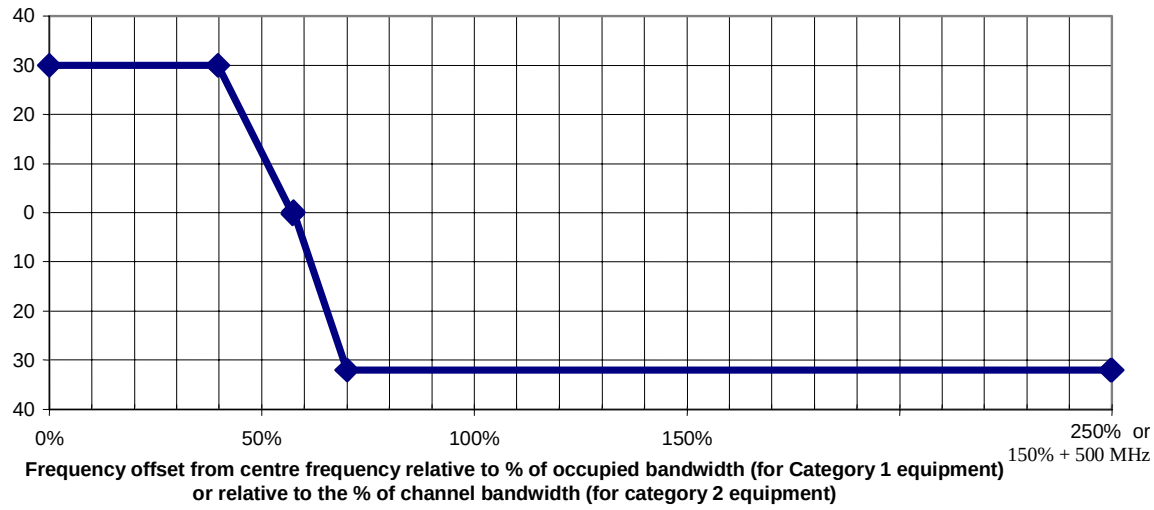
The mask of figure 1 is not inclusive of frequency tolerance.

The present document considers also that maximum EIRP density is generally set by administrations in order to define Power Flux Density (PFD) levels as a co-ordination trigger between different geographical areas or for cross-border agreements. However, it introduces the tables 2 and 3 giving guidance, for possible maximum limits, based on currently available technology which already takes into account an allowance for the future development of higher power transmitters.

In addition, for regulatory reasons, the occupied bandwidth shall remain within the specified band 64 GHz to 66 GHz. Nevertheless, out-of-band emissions (i.e. those exceeding the 50 % abscissa in figure 1) of systems operating close to the 64 GHz to 66 GHz band edge, may still fall outside the band edges up to the boundary of the spurious emissions domain; consequently the EIRP spectral density falling outside of the 64 GHz to 66 GHz band edges shall also not exceed the limit of:

- -20 dBW/MHz.

Figure 2 and table 2 show the required EIRP and density mask for all equipment.



EIRP density (dBW/MHz)	Offset (% of occupied bandwidth) (see note 1)
30	0
30	40
0	57,5
-32	70
-32	250 or 150 + 500 MHz (Note 2)

NOTE 1: See definition of Occupied bandwidth in clause 3.1.
NOTE 2: The 250% value applies only for occupied bandwidth ≤ 500 MHz; the second one for occupied bandwidth > 500 MHz.

Figure 2: Tx EIRP spectral density mask

Table 2: Maximum allowed transmitter EIRP spectral density

Max EIRP spectral density (Including tolerances) (see note 2)	Typical informative assumptions for deriving the EIRP limits (see note 1)	
	Maximum power spectral density at antenna port	Maximum antenna gain
+30 dBW/MHz	+15 dBm/MHz	+45 dBi

NOTE 1: In actual applications trade off in these values is possible provided that EIRP limits are met.
NOTE 2: Limited by the maximum EIRP of +33 dBW.

4.8.2.3 Spurious emissions

The equipment shall comply with the spurious emission limits defined in CEPT/ERC Recommendation 74-01 [4] (see note).

NOTE: According that Recommendation, for category 1 equipment, the frequency boundary where limits apply for fixed service systems needs to be evaluated as a function of the occupied bandwidth of the emission.

The limits are applicable at reference point C' or at point B' if C' is not available. The equipment shall comply with the relevant requirements in any setting conditions of transmit power. Test methods shall be in accordance with clause 5.2.9 of EN 301 126-1 [2].

The tests shall be carried out to produce the test report and/or declaration of conformity required (Directive 1999/5/EC [1]) with equipment set to maximum available power. The actual test shall be limited to the practical frequency ranges foreseen by CEPT/ERC Recommendation 74-01 [4].

The test shall be carried out at reference climatic conditions according to clause 4.4 of EN 301 126-1 [2].

4.9 Antennas and RF interface

4.9.1 Antenna requirements

Requirements for the antenna radiation patterns are identical to those given in figures 25 (frequency range 6, Class 2) and 26 (frequency range 6, Class 3a) of EN 302 217-4-2 (see bibliography).

4.9.2 RF interface

In case of integral antennas, the manufacturer shall indicate the methodology for testing for radio frequency characteristics.

4.10 Receiver requirements

When operating in accordance with the scope of the present document, the only essential receiver phenomena are related to spurious emissions. Other receiver specifications, considered non-essential for the purpose of the present document, are shown in annex A.

4.10.1 Spurious emissions - external

The spurious emission limits defined in CEPT Recommendation 74-01 [4] shall apply (see note). Those limits are applicable at reference point C or at point B if C is not available.

NOTE: According that Recommendation, for category 1 equipment, the frequency boundary where limits apply for fixed service systems needs to be evaluated as a function of the occupied bandwidth of the emission.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

The technical requirements of the present document apply under the environmental profile for intended operation of the system, which shall be declared by the manufacturer.

The environmental profile may be determined by the environmental class of the equipment according to the guidance given in clause 4.2 of EN 301 126-1 [2].

The equipment shall comply with all the requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

Any test, requested to generate the test report and/or declaration of conformity in order to fulfil any conformity assessment procedure foreseen by the R&TTE Directive [1], shall be carried-out:

a) for radio equipment, with respect to the same principles and procedures, for reference and extreme conditions, set out in clause 4.4 of EN 301 126-1 [2];

b) for integral DFRS antennas (directional phenomena of clause 4.6 of the present document), at reference environmental conditions of the test field according to clause 4.1 of EN 301 126-3-1 [3].

The test report shall be produced according to the procedure set out by article 10 of the Directive 1999/5/EC [1].

5.2 Wide radio-frequency band covering equipment specification and tests

DFRS equipment commonly covers an operating frequency range. The equipment parameters shall comply with all the requirements of the present document at any possible operating frequency.

The tests, requested to generate the test report and/or declaration of conformity in order to fulfil any conformity assessment procedure foreseen by the Directive 1999/5/EC [1], shall be carried-out at the highest and the lowest possible operating frequency.

5.3 Radio test suites

Tables 3 and 4 indicate the different clauses applicable, for a given parameter, to the requirement, the test clause and the corresponding test method in the base test documents EN 301 126-1 [2] and EN 301 126-3-1 [3].

The test methods for the requirements considered essential are stated, where applicable, in table 3. The test methods for the requirements considered non-essential are stated, where applicable, in table 4.

Table 3: test methods for compliance with technical requirements considered essential

Clause	Relevant clause title	Test method
General		
4.2	Environmental specifications and tests	Clause A.1.3.3, EN 301 126-1 [2]
Transmitter/antenna	**--------**	**---------**
4.5.1	Frequency error/stability (radio frequency tolerance)	Clause 5.2.5, EN 301 126-1 [2]
4.5.2.1	Transmitter maximum EIRP limit	Clause 5.2.1, EN 301 126-1 [2] and/or Clause 6.3, EN 301 126-3-1 [3]
4.5.2.2	Adjacent channel power (EIRP density mask)	Clause 5.2.6, EN 301 126-1 [2] Clause 6.3, EN 301 126-3-1 [3]
4.5.2.3	Spurious Emissions	Clause 5.2.9, EN 301 126-1 [2]
4.6.1	Off-axis EIRP density (RPE)	Clause 6.1, EN 301 126-3-1 [3]
4.6.2	Antenna gain	Clause 6.3, EN 301 126-3-1 [3]
Receiver	**---------**	**---------**
4.7.1	Spurious Emissions	Clause 5.3.2, EN 301 126-1 [2]

Table 4: test methods for compliance with technical requirements (considered non-essential)

Clause Receiver	Relevant clause title	Test method
B.1	BER as a function of receiver input signal level RSL	Clause 5.3.3.1, EN 301 126-1 [2]
B.2	Co-channel "external" interference sensitivity	Clause 5.3.3.2, EN 301 126-1 [2]
B.3	CW spurious interference	Clause 5.3.3.4, EN 301 126-1 [2]

Annex A (informative): Receiving requirements

When operating in accordance within the scope of the present document, the only essential receiving phenomena are related to spurious emissions. Other receiver specifications, considered non-essential for the purpose of the present document, are shown within this annex.

A.1 BER as a function of receiver input signal level (RSL)

All parameters are referred to reference point C (for systems with a simple duplexer) or B (for systems with a multi-channel branching system). Losses in RF couplers (possibly used for protected systems) are not taken into account in the limits specified below.

When packet data transmission is considered, any BER requirements should be transformed into FER requirements according to the rules given in annex G.4 of EN 302 217-2-1 (see bibliography).

The RSL threshold values (dBm) for required BER are indicated in tables A.1 and A.2.

Equipment working at the relevant RSL thresholds, set out in table A.1 (as limits for category 1) or table A.2 (as typical values for category 2), should produce a BER equal to or less than the corresponding values (i.e. 10^{-6} or 10^{-8}).

NOTE: The actual RSL threshold for link budget definition may be defined by the manufacturer, generally set to a BER between 10^{-6} and 10^{-3}, according to the type of traffic and quality of service to be provided.

Table A.1: BER as a function of RSL for category 1 systems

Bit-rate (Mbit/s)	Spectral efficiency class (see note 1)	RSL for BER ≤ 10^{-6} (dBm) (see note 2)	RSL for BER ≤ 10^{-8} (dBm) (see note 2)
125	1	-61	-59,5
155	1	-60	-58,5
622	2	-48	-46,5
1 250	2	-42	-40,5
NOTE 1: The spectral efficiency Classes are defined in the scope. NOTE 2: Values are related to symmetric TDD systems of the simplest class 1 and 2 modulation formats (e.g. OOK/ASK/FSK or 4ASK/4FSK, respectively); more complex formats of same classes (e.g. PSK or QPSK/4QAM, respectively) may offer better performance. In addition, FDD systems, when duplex operation is applicable, offer, in principle, 3 dB better values.			

Table A.2: Typical receiver power density levels for category 2 systems.

Spectral efficiency class	1 (Note 1)	2 (Note 2)	3	4 (Note 3)	5 (Note 3)
RSL[dBm/MHz] for BER ≤ 10^{-6}	–91,5	–88,5	–83	-81,5 (16 QAM) / -78,5 (32 QAM)	-75,5 (64 QAM) / -72,5 (128 QAM)
RSL[dBm/MHz] for BER ≤ 10^{-8}	–89	–86	–80,5	-79 (16 QAM) / -76 (32 QAM)	-73 (64 QAM) / -70 (128 QAM)
NOTE 1: Values based on typical PSK formats; other simpler formats (e.g. OOK/FSK) may exhibit worse values. NOTE 2: Values based on typical 4 PSK/4 QAM formats; simpler modulation formats (e.g. 4 FSK/4 ASK) may exhibit worse values. NOTE 3: The range of values is related to possibly different formats within the class (e.g. 16/32 QAM in class 4 and 64/128 QAM in class 5).					

The typical RSL of actual systems can be derived integrating the values in table A.2 over a bandwidth equal to the peak symbol-rate actually transmitted on air or, in the slightly more conservative way, over the Occupied or Channel bandwidth.

A.2 Co-channel "external" and adjacent channel interference sensitivity

The co-channel "external" interference is considered to be that given by a like signal completely uncorrelated with the one under test.

All Carrier to Interference ratio (C/I) measurements are referred to reference point C.

The limits of Carrier to Interference ratio (C/I) in case of co-frequency channel and adjacent channel interference shall be as specified in table A.3, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits specified for a BER $\leq 10^{-6}$ in clause A.1.

For category 1 equipment the limits of table A.3 are applied for co-channel and first adjacent channel interference sensitivity.

The limits of table A.3 are applied for co-channel and first adjacent channel interference sensitivity.

Table A.3: Co-channel and 1st adjacent channel interference sensitivity

C/I (dB) for BER ≤10^{-6} RSL degradation of 1 dB or 3 dB				
Spectrum efficiency class ↓	**Co-channel**		**Adjacent channel**	
	1 dB	**3 dB**	**1 dB**	**3 dB**
1	23	19	0	-4
2	23	19	0	-4
3	23	19	-1	-5
4	30	26	-1	-5
5	37	33	-3	-7
NOTE: For category 1 systems only classes 1 and 2 are applicable.				

Test of adjacent channel C/I degradation shall be done with two systems of same bandwidth with centre frequencies spacing equal to the occupied bandwidth (category 1) or occupied channel (category 2). Assessment is not applicable for occupied or channel bandwidth exceeding 1 000 MHz.

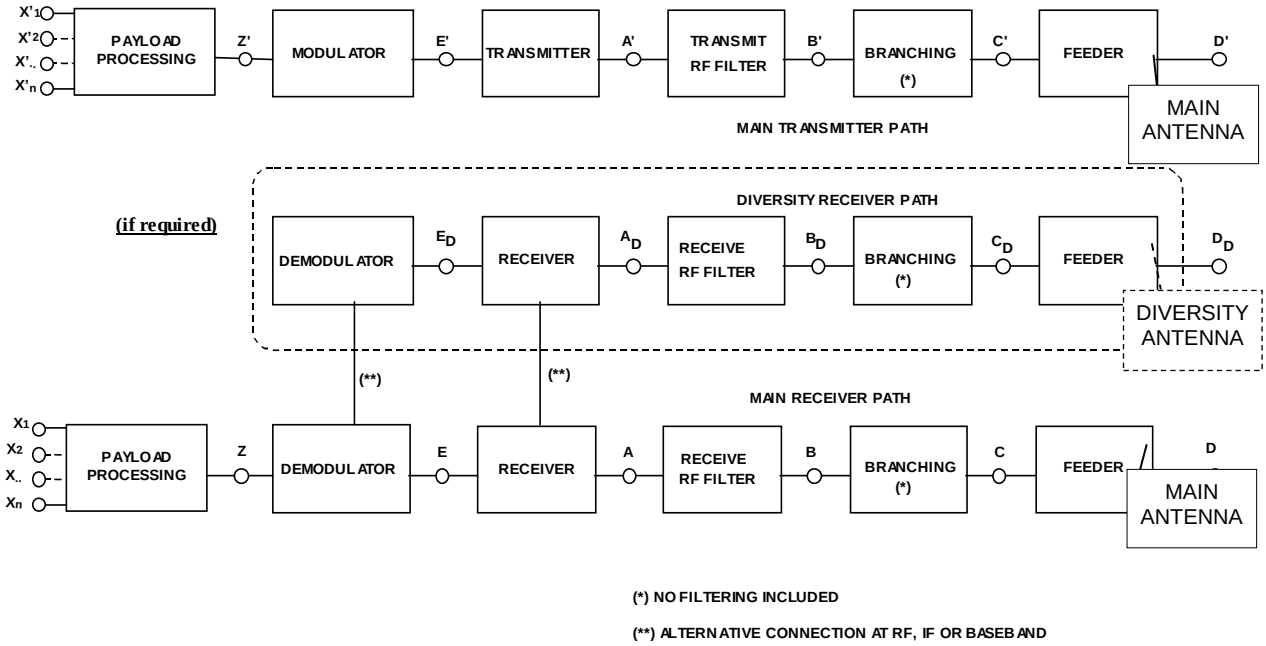
A.3 CW spurious interference

For a receiver operating at the RSL specified in clause A.1 for a BER $\leq 10^{-6}$ threshold, the introduction of a CW interferer at a level specified by EN 301 390 [6], with respect to the wanted signal and at any frequency up to the relevant upper and lower frequency limits derived from the table set out in clause 7.1 of EN 301 390 [6], but excluding frequencies either side of the wanted frequency by up to 250 % of the channel separation (or the occupied bandwidth for category 1 equipment) using the same polarization, shall not result in a BER greater than 10^{-5}.

This test is designed to identify specific frequencies at which the receiver may have a spurious response; e.g. image frequency, harmonics of the receive filter, etc. The actual test range should be adjusted accordingly. The test is not intended to imply a relaxed specification at all out of band frequencies elsewhere specified in the present document.

Annex B (informative): System block diagram

The reference points of the system block diagram (figure B.1) will be used in the descriptions of requirements and of test points in the other parts of the present document.



NOTE 1: For the purpose of defining the measurement points, the branching network does not include a combiner.
NOTE 2: The points shown above are reference points only and do not mandate any implementation; points C and C', D and D' in general coincide.
NOTE 3: Points B, C, B' and C' may coincide when a simple duplexer is used.
NOTE 4: Points X1, X2, …Xn and points X'1, X'2, …X'n correspond to one or more digital or analogue signal input reference points. They are generically referred to as X and X'.
NOTE 5: The subdivision of "Payload processing" and the "Modulator/demodulator" blocks is functional and not physical. The first functionally contains the payload processing needed for building up the transport module (e.g. framing, multiplexing and/or concentration), the latter functionally contains mo-demodulation, coding-decoding and service signals processing needed for transmission (e.g. error correction algorithms and service channels). Points Z and Z', that might not be physically available, represent the virtual points where , the radio interface capacity (RIC), referred in the provisions of annex F of parts 2-1 and 2-2 of the multi-part EN 302 217 (see bibliography) shall be defined.

Figure B.1: System block Diagram

Annex C (informative): Bibliography

- ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the R&TTE Directive".
- ETSI TR 101 506: "Fixed Radio Systems; Generic definitions, terminology and applicability of essential requirements under the article 3.2 of 99/05/EC Directive to Fixed Radio Systems".
- ETSI EN 302 217 (all parts): "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas".

History

Document history		
V1.1.1	May 2004	Publication
V1.2.1	June 2007	Publication