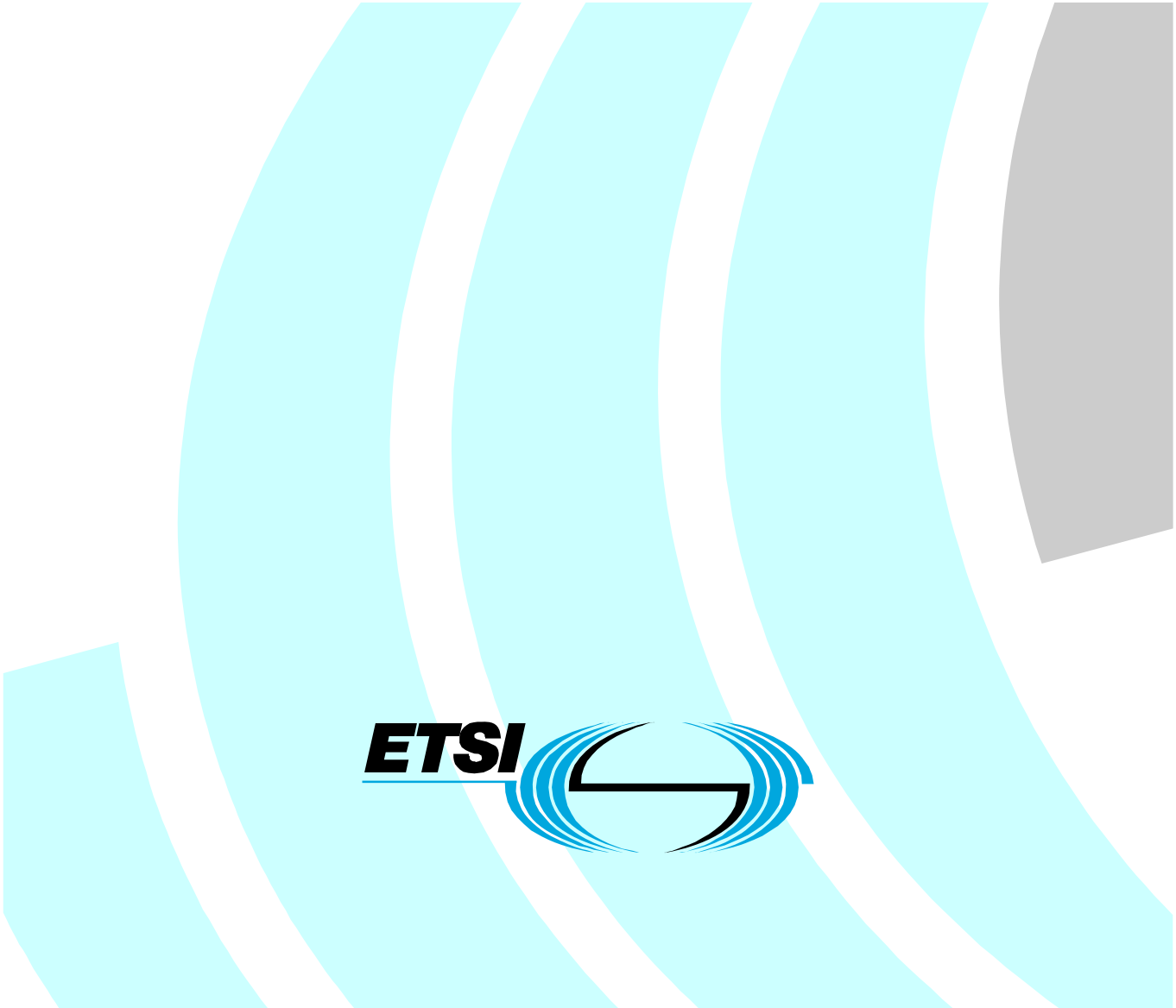
Final draft ETSI EN 302 217-2-2 V1.3.1 (2008-12)

Harmonized European Standard (Telecommunications series)

Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-2: Digital systems operating in frequency bands where frequency co-ordination is applied; Harmonized EN covering the essential requirements of Article 3.2 of the R&TTE Directive



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Contents

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Foreword

This Harmonized European Standard (Telecommunications series) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM), and is now submitted for the ETSI standards One-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC (as amended) [i.2] laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Directive 1999/5/EC [1] 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").

The present document is part 2, sub part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [6].

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

Introduction

The EN 302 217 [6] series has been produced in order to rationalize a large number of previous ETSI ENs dealing with equipment and antennas for Point-to-Point (P-P) Fixed Service applications. For more details, see foreword in the EN 302 217-1 [6].

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive [1]. The modular structure is described in EG 201 399 [i.21] and shown in figure 1.

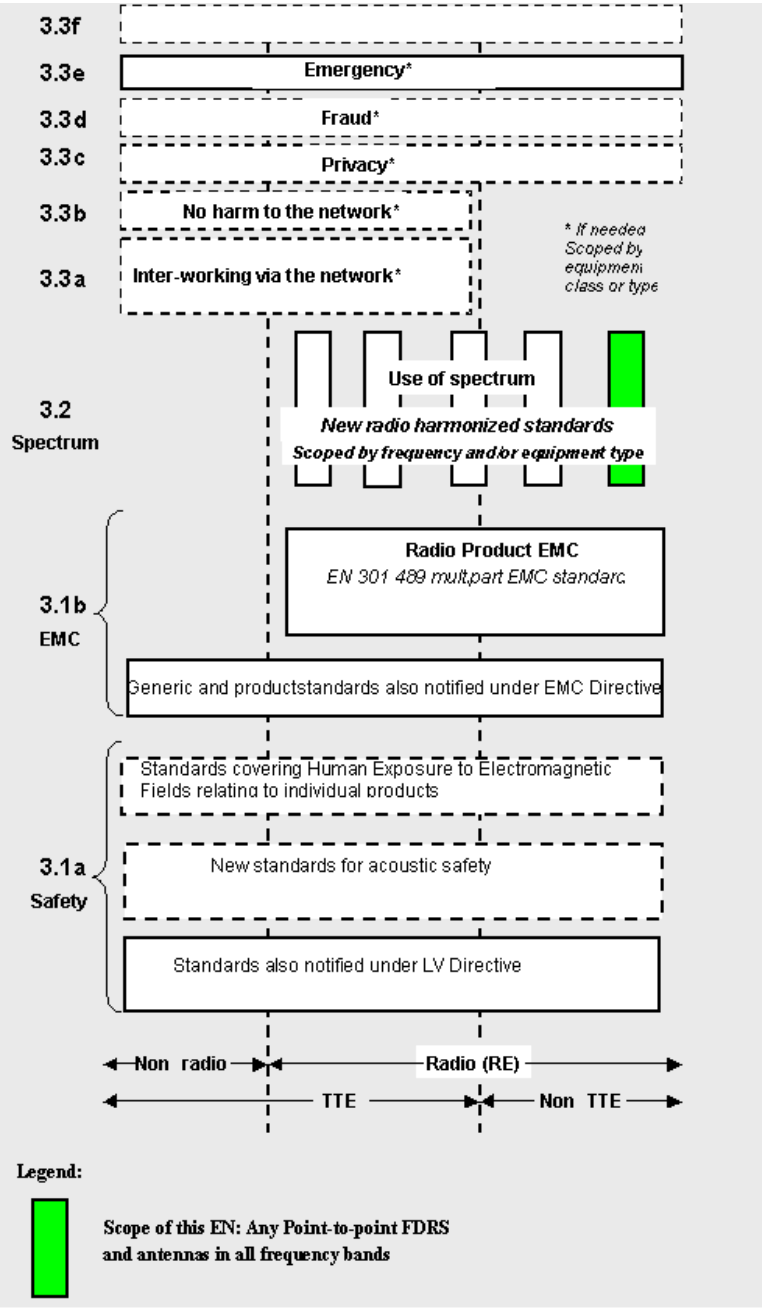


Figure 1: Modular structure for the various standards used under the R&TTE Directive

NOTE: For article 3.1b the diagram shows EN 301 489 [i.22], [i.36], the multi-part product EMC standard for radio used under the EMC Directive 89/336/EEC [i.1]. For Fixed Radio Systems EN, EN 301 489-1 [i.22] and EN 301 489-4 [i.23] are relevant.

1 Scope

1.1 General background

The present document specifies the essential requirements for point to point Digital Fixed Radio Systems (DFRS) operating in frequency bands, which require co-ordinated frequency planning. It is intended to cover the provisions of the R&TTE Directive [1] regarding article 3.2, which states that "… radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive [1] will apply to equipment within the scope of the present document.

NOTE: A list of such ENs is included on the web site http://www.newapproach.org.

1.2 Spectral efficiency classes

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 typical 2-states modulation scheme (e.g. 2-FSK, 2-PSK or equivalent).
- Class 2: equipment spectral efficiency based on typical 4-states modulation scheme (e.g. 4-FSK, 4-QAM, or equivalent).
- Class 3: equipment spectral efficiency based on typical 8-states modulation scheme (e.g. 8-PSK, or equivalent) (see note 1).

NOTE 1: It is also noted that, in this class, for design commonality with other efficiency classes, the 16 QAM format is popular.

- Class 4L: equipment spectral efficiency based on typical 16-states modulation scheme (e.g. 16-QAM, 16-APSK, or equivalent) (see note 2).

NOTE 2: It is also noted that, in this class, for flexible implementation trade-off between the actual Radio Interface Capacities (RIC) and roll-off shaping, the 32 QAM format is also popular.

- Class 4H: equipment spectral efficiency based on typical 32-states modulation scheme (e.g. 32-QAM, 32-APSK, or equivalent).
- Class 5A: equipment spectral efficiency based on typical 64-states or 128-states modulation scheme (e.g. 64-QAM or 128-QAM, or equivalent), for cross-polar adjacent channel (ACAP) operation.
- Class 5B: equipment spectral efficiency based on typical 64-states or 128-states modulation scheme (e.g. 64-QAM or 128-QAM, or equivalent), for co-polar adjacent channel (ACCP) and frequency reuse through CCDP operation.
- Class 6A: equipment spectral efficiency based on typical 256-states or 512-states modulation scheme (e.g. 256-QAM or 512-QAM, or equivalent), for cross-polar adjacent channel (ACAP) operation.
- Class 6B: equipment spectral efficiency based on typical 256-states or 512-states modulation scheme (e.g. 256-QAM or 512-QAM, or equivalent), for co-polar adjacent channel (ACCP) and frequency reuse through CCDP operation.

The above classes are indicative only and shall not imply any constraint to the actual modulation format, provided that all the requirements in the relevant parts of this EN 302 217 series are met.

1.3 System alternatives

In order to (technically) cover different market and network requirements, with an appropriate balance of performance to cost and effective and appropriate use of the radio spectrum, the present document, together with EN 302 217-4-2 [7], offers a number of system types and antennas alternatives, for selection by administrations, operators and manufacturers dependent on the desired use of the radio spectrum and network/market requirements; those options include:

- channel separation alternatives (as provided by the relevant CEPT or ITU-R Recommendation);
- spectral efficiency class alternatives (different modulation formats provided in radio equipment standards) as defined in clause 1.2 above; actual equipment may operate within one spectral efficiency class only (*Single-mode*) or within multiple classes, either with static preselection of the class (*Preset- mode*) or with dynamic variation of class according the propagation conditions (*Mixed-mode*) (see note);
- antenna directivity class alternatives (for different network requirements).

NOTE: *Single- mode, Preset-mode and Mixed-mode* systems are defined in clause 3.1 of EN 302 217-1 [6]; additional information on *Mixed-mode* systems may be found in annex I of the present document.

1.4 Channel arrangements and utilization

From the point of view of the transmission capacity, these systems are defined, in the relevant annexes, on the basis of their minimum Channel Separation (CS) on the same route, for a given spectrum efficiency class, taken into account by the system design. The possible channel arrangements may be:

- Adjacent Channel Alternate-Polarized (ACAP);
- Adjacent Channel Co-Polarized (ACCP);
- Co-Channel Dual-Polarization (CCDP).

These possible applications and their channel arrangements are shown in figure 2.

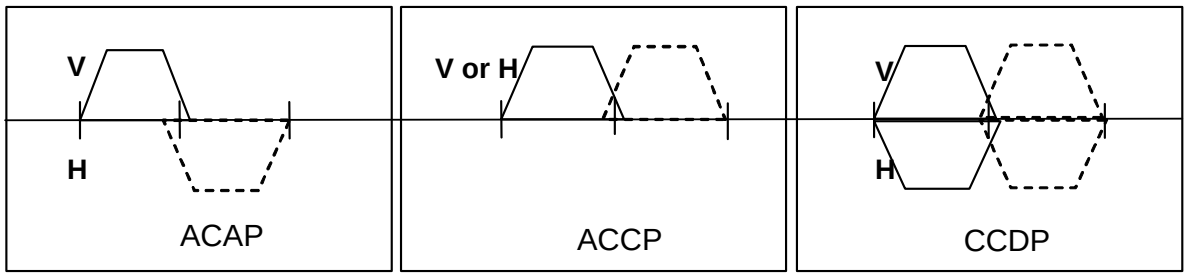


Figure 2: Examples of channel arrangements on the same route

1.5 Payload flexibility

The capacities in tables X.2 (where X = B…E represents the relevant annex) are commonly tailored on typical PDH and SDH base band interfaces, identified for simplicity with 2 Mbit/s, 2 × 2 Mbit/s, 8 Mbit/s, 2 × 8 Mbit/s, 34 Mbit/s, 2 × 34 Mbit/s, STM-0 (51 Mbit/s), 2 × STM-0 (2 × 51 Mbit/s), STM-1 (155 Mbit/s), N × STM-1 (N × 155 Mbit/s), STM-N. Systems in annex A, due to the smaller channel separation provided, are (exceptionally) labelled with typical capacity rate without specific reference to PDH/SDH rates.

Provided that they meet all requirements of the relevant annex, equivalent or higher PDH or SDH transport rates may be used where appropriate. Such equivalence transport rates may be:

- N × 2 Mbit/s or other mixture of PDH rates, even if multiplexed into proprietary frames, in place of higher order PDH or SDH rates;
- 140 Mbit/s (including the above N × 2 Mbit/s or other mixture of PDH rates) in place of STM-1;

- any PDH mapping into STM-0 or STM-1 frames, as defined in the basic multiplexing schemes;
- N × 2 Mbit/s mapped into SDH VC12 or VC2 transport bit rates (sub-STM-0 defined, as sSTM-1k or sSTM-2n capacities, by ITU-T Recommendation G.708 [i.49]) in place of a PDH rate (e.g. 4 × VC12/sSTM14 or 1 × VC2/sSTM21 in place of 8 Mbit/s) (see note);
- any other signal (e.g. IP frames or ATM cells, even possibly mixed with PDH capacities) mapping into PDH or SDH frames, according present or future basic ITU-T or ETSI multiplexing schemes;

NOTE: In addition to this general principle, annex D (system D.2) presents specific characteristics for sub-STM-0 systems in the 18 GHz band.

The present document is also applicable to other base band interfaces (e.g. packet data interfaces or mixed interfaces) even if multiplexed (including compression algorithms if any) into proprietary frames; for such cases annex F gives the basic rules for applying the conventional PDH/SDH set of parameters to those equipment assessment.

Equipment may operate with one single payload rate or with multiple payload rates (multirate systems), either statically preset (possibly coupled also with *Preset-mode* operation) or, when coupled with *Mixed-mode* operation, dynamically changing according to the modulation format.

The requirements of the present document apply separately to each transmitter/receiver or single transmitters or receivers used for combining complex or simple (e.g. space diversity receivers or single transmitters and receivers used for unidirectional links) fixed radio systems. Systems labelled with N × STM-1 (N = 1,2) capacity might actually be aggregated for carrying STM-4 in more than one radio frequency channel, provided that each equipment for each channel meets the channel requirements. When frequency reuse (e.g. dual polarization reuse or other frequency reuse techniques) is applied, the requirements apply independently to each transmitter/receiver; the different interference potential of frequency reuse will be dealt with in the frequency planning associated with the licensing process.

1.6 Document structure

The present document is mainly intended to cover fixed radio equipment without integral antennas. However, it also applies to fixed radio systems products with integral antennas, for which all the technical requirements included in the present document and in EN 302 217-4-2 [7] apply. For more background information on the equipment and antenna parameters here identified as relevant to article 3.2 of R&TTE Directive see EG 201 399 [i.21] and TR 101 506 [i.25].

For simplicity, the point-to-point systems are split into separate annexes, with respect to ranges of frequency bands and channel separations, into the following families which may include a range of corresponding payload rates for covering various applications requested by the market:

- Annex A: Frequency bands from 1,4 GHz to 2,7 GHz:

  Systems with channel separations ranging from 0,025 MHz to 14 MHz for indicative payload rates ranging from 0,0096 Mbit/s to 34 Mbit/s. See detailed summary in table A.2.

- Annex B: Frequency bands from 3 GHz to 11 GHz (channel separation up to 30 MHz and 56/60 MHz):

  Systems with channel separations ranging from 1,75 MHz to 30 MHz and 56/60 MHz for indicative payload rates ranging from 2 Mbit/s to STM-4/4 × STM-1 Mbit/s. See detailed summary in table B.2.

- Annex C: Frequency bands from 3 GHz to 11 GHz (channel separation 40 MHz):

  Systems with channel separations 40 MHz (or spread over 2 × 40 MHz) for indicative payload rates from STM-1 Mbit/s to STM-4/4 × STM-1 Mbit/s. See detailed summary in table C.2.

- Annex D: Frequency bands 13 GHz, 15 GHz and 18 GHz:

  Systems with channel separations ranging from 1,75 MHz to 55/56 MHz (or spread over 2 × 55/56 MHz) for indicative payload rates ranging from 2 Mbit/s to STM-4/4 × STM-1 Mbit/s. See detailed summary in table D.2.

- Annex E: Frequency bands from 23 GHz to 55 GHz:

  Systems with channel separations ranging from 3,5 MHz to 56 MHz (or spread over 2 × 56 MHz for indicative payload rates ranging from 2 Mbit/s to STM-4/4 × STM-1 Mbit/s. See detailed summary in table E.2.

In those annexes further subdivision in sub-annexes is made, as appropriate, according to frequency bands, capacities and/or channel separation (see table 3 of EN 302 217-1 [6]).

2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

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

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[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] CEPT/ERC/REC 74-01 (2005): "Unwanted Emissions in the Spurious Domain".

[3] ETSI EN 301 126-1 (V1.1.2): "Fixed Radio Systems; Conformance testing; Part 1: Point-to-point equipment - Definitions, general requirements and test procedures".

[4] ETSI EN 301 126-3-1 (V1.1.2): "Fixed Radio Systems; Conformance testing; Part 3-1: Point-to-Point antennas; Definitions, general requirements and test procedures".

[5] ETSI EN 301 390 (V1.2.1): "Fixed Radio Systems; Point-to-point and Multipoint Systems; Spurious emissions and receiver immunity limits at equipment/antenna port of Digital Fixed Radio Systems".

[6] ETSI EN 302 217-1 (V1.2.1): "Fixed Radio Systems; Characteristics and requirements for point to-point equipment and antennas; Part 1: Overview and system-independent common characteristics".

[7] ETSI EN 302 217-4-2 (V1.4.1): "Fixed Radio Systems; Characteristics and requirements for point to-point equipment and antennas; Part 4-2: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for antennas".

[8] IEEE 1802.3-2001: "IEEE Conformance Test Methodology for IEEE Standards for Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[9] IEEE 802.3-2005: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[10] ITU Radio Regulations (2004).

[11] ITU-T Recommendation O.151 (1992) Corrigendum 1 (2002): "Error performance measuring equipment operating at the primary rate and above".

[12] ITU-T Recommendation O.181 (2002): "Equipment to assess error performance on STM-N interfaces".

[13] ITU-T Recommendation O.191 (2000): "Equipment to measure the cell transfer performance of ATM connections".

2.2 Informative references

The following referenced documents are not essential to the use of the ETSI deliverable but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).

[i.2] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.

[i.3] CEPT/ERC/REC 01-02: "Preferred channel arrangement for digital fixed service systems operating in the frequency band 31.8 - 33.4 GHz".

[i.4] CEPT/ECC/REC 02-02: "Channel arrangement for digital fixed service systems (point-to-point and point-to-multipoint) operating in the frequency band 31 - 31.3 GHz".

[i.5] CEPT/ECC/REC 02-06: "Preferred channel arrangements for digital fixed service systems operating in the frequency range 7125-8500 MHz".

[i.6] CEPT/ERC/REC 12-02: "Harmonized radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 12.75 GHz to 13.25 GHz".

[i.7] CEPT/ERC/REC 12-03: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 17.7 GHz to 19.7 GHz".

[i.8] CEPT/ERC/REC 12-05: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10.0 - 10.68 GHz".

[i.9] CEPT/ERC/REC 12-06: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10.7 GHz to 11.7 GHz".

[i.10] CEPT/ERC/REC 12-07: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 14.5 - 14.62 GHz paired with 15.23 - 15.35 GHz".

[i.11] CEPT/ERC/REC 12-08: "Harmonized radio frequency channel arrangements and block allocations for low, medium and high capacity systems in the band 3600 MHz to 4200 MHz".

[i.12] CEPT/ERC/REC 12-10: "Harmonized radio frequency arrangements for digital systems operating in the band 48.5 GHz - 50.2 GHz".

[i.13] CEPT/ERC/REC 12-11: "Radio frequency channel arrangement for fixed service systems operating in the band 51.4-52.6 GHz".

[i.14] CEPT/ERC/REC 12-12: "Radio frequency channel arrangement for fixed service systems operating in the band 55.78-57.0 GHz".

[i.15] CEPT/ERC/REC 14-01: "Radio-frequency channel arrangements for high capacity analogue and digital radio-relay systems operating in the band 5925 MHz - 6425 MHz".

[i.16] CEPT/ERC/REC 14-02: "Radio-frequency channel arrangements for medium and high capacity analogue or high capacity digital radio-relay systems operating in the band 6425 MHz - 7125 MHz".

[i.17] CEPT/ERC/REC 14-03: "Harmonized radio frequency channel arrangements for low and medium capacity systems in the band 3400 MHz to 3600 MHz".

[i.18] CEPT/ERC/REC T/R 12-01: "Harmonized radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 37-39.5 GHz".

[i.19] CEPT/ERC/REC T/R 13-01: "Preferred channel arrangements for fixed services in the range 1-3 GHz".

[i.20] CEPT/ERC/REC T/R 13-02: "Preferred channel arrangements for fixed services in the range 22.0 - 29.5 GHz".

[i.21] ETSI EG 201 399 (V2.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the R&TTE Directive".

[i.22] 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".

[i.23] 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".

[i.24] ETSI EN 302 217-2-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-1: System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied".

[i.25] ETSI TR 101 506 (V1.2.1): "Fixed Radio Systems; Generic definitions, terminology and applicability of essential requirements under the article 3.2 of 1999/05/EC Directive to Fixed Radio Systems".

[i.26] ETSI TR 101 854: "Fixed Radio Systems; Point-to-point equipment; Derivation of receiver interference parameters useful for planning fixed service point-to-point systems operating different equipment classes and/or capacities".

[i.27] ETSI TR 102 243-1: "Fixed Radio Systems; Representative values for transmitter power and antenna gain to support inter- and intra-compatibility and sharing analysis; Part 1: Digital point-to-point systems".

[i.28] ITU-R Recommendation F.382-8: "Radio-frequency channel arrangements for radio-relay systems operating in the 2 and 4 GHz bands".

[i.29] ITU-R Recommendation F.383-8: "Radio-frequency channel arrangements for high capacity radio-relay systems operating in the lower 6 GHz band".

[i.30] ITU-R Recommendation F.384-10: "Radio-frequency channel arrangements for medium and high capacity digital fixed wireless systems operating in the upper 6 GHz band".

[i.31] ITU-R Recommendation F.385-9: "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".

[i.32] ITU-R Recommendation F.386-8: "Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the 8 GHz band".

[i.33] ITU-R Recommendation F.387-10: "Radio-frequency channel arrangements for radio-relay systems operating in the 11 GHz band".

[i.34] ITU-R Recommendation F.497-7: "Radio-frequency channel arrangements for radio-relay systems operating in the 13 GHz frequency band".

[i.35] ITU-R Recommendation F.595-9: "Radio-frequency channel arrangements for fixed wireless systems operating in the 18 GHz frequency band".

[i.36] ITU-R Recommendation F.635-6: "Radio-frequency channel arrangements based on a homogeneous pattern for radio-relay systems operating in the 4 GHz band".

[i.37] ITU-R Recommendation F.636-3: "Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band".

[i.38] ITU-R Recommendation F.637-3: "Radio-frequency channel arrangements for fixed wireless systems operating in the 23 GHz band".

[i.39] ITU-R Recommendation F.746-9: "Radio-frequency channel arrangements for radio-relays systems".

[i.40] ITU-R Recommendation F.747: "Radio-frequency channel arrangements for fixed wireless systems operating in the 10 GHz band".

[i.41] ITU-R Recommendation F.748-4: "Radio-frequency arrangements for systems of the fixed service operating in the 25, 26 and 28 GHz bands".

[i.42] ITU-R Recommendation F.749-2: "Radio-frequency channel arrangements for radio-relay systems in the 38 GHz band".

[i.43] ITU-R Recommendation F.1099-4: "Radio-frequency channel arrangements for high and medium capacity digital fixed wireless systems in the upper 4 GHz (4 400-5 000 MHz) band".

[i.44] ITU-R Recommendation F.1191-2: "Bandwidths and unwanted emissions of digital fixed service systems".

[i.45] ITU-R Recommendation F.1496-1: "Radio-frequency channel arrangements for fixed wireless systems operating in the band 51.4-52.6 GHz".

[i.46] ITU-R Recommendation F.1497-1: "Radio-frequency channel arrangements for fixed wireless systems operating in the band 55.78-59 GHz".

[i.47] ITU-R Recommendation F.1520-2: "Radio-frequency arrangements for systems in the fixed service operating in the band 31.8-33.4 GHz".

[i.48] ITU-R Recommendation SM.329-10: "Unwanted emissions in the spurious domain".

[i.49] ITU-T Recommendation G.708 (1999): "Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in EN 302 217-1 [6] apply.

3.2 Symbols

For the purposes of the present document, the symbols given in EN 302 217-1 [6] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in EN 302 217-1 [6] apply.

4 Technical requirements specifications

Guidance and description of the phenomena relevant to "essential requirements" under article 3.2 is given in EG 201 399 [i.21]; specific applications and descriptions for DFRS is given in TR 101 506 [i.25].

In the following clauses, limits are required to be met at specific reference points of the system block diagram. Reference points and the system block diagram are set out in figure 1 of EN 302 217-1 [6].

In the case of wide radio-frequency bands covering units and multirate/multiformat equipment, these specifications shall be met at any frequency, at any rate/format. However the tests, required for generating a test report and/or declaration of conformity, in order to fulfil any conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out in accordance with the principles set out in annex G.

Testing methods and conditions for assessing all requirements are specified in clause 5, where each clause directly refers to a corresponding clause in this clause 4 (e.g. clause 5.2.2.1.1 refers to the ATPC test according the requirement in clause 4.2.2.1.1).

The requirements are intended, for applicable systems, with fully loaded STM-4 or 4 × STM-1 or 2 × STM-1 or STM-1 (according to the maximum loading required for the equipment) capacities at the base band interface. However, for CCDP application test reports, the actual contemporary loading of both polarization transmitters is not required.

NOTE: For each technical requirement in the present document, there might be additional characteristics, not considered relevant to article 3.2 of the R&TTE Directive [1]. Nevertheless they are considered important for the system itself or for deployment conditions where local antenna sharing between equipments of different suppliers is required; these additional requirements, when identified, may be found in EN 302 217-2-1 [i.24].

4.1 Environmental profile

The required environmental profile for operation of the equipment shall be declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the required operational environmental profile.

For testing the compliance to technical requirements see also EN 301 126-1 [3] and clause 5 of the present document.

NOTE: With the generic term of environmental profile, it is here intended any variation of the "external" conditions (e.g. climatic and external primary/secondary power supply sources feeding the equipment to be assessed) that might affect the system parameters relevant to the "essential requirements" of article 3.2 of the R&TTE Directive [1].

4.2 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 1 of EN 302 217-1 [6].

Table 1 gives the appropriate base band signals.

Table 1: Test signal and type of base band interface

Type of base band signal interface at X/X'	Test signal to be applied according to
PDH	PRBS ITU-T Recommendation O.151 [11]
SDH	ITU-T Recommendation O.181 [12]
ATM	ITU-T Recommendation O.191 [13]
Ethernet interface (packet data) (see note)	IEEE 1802.3 [8] and IEEE 802.3 [9]
Other than the above (see note)	Relevant standards which the interface refers to
NOTE: As a general approach, all system characteristics and spectral efficiency classes are defined on conventional PDH or SDH transport capacity. However, whenever equipment offers a different standardized transport capacity, annex F gives the minimal criteria and the test rules for defining an equivalent PDH/SDH system type, for the same CS and spectral efficiency, which parameters shall be used for assessing such equipment.	

4.2.1 Transmitter power

The maximum power shall be limited, in term of EIRP of the systems by the provisions given in the Radio Regulations [10] (e.g. in article 21 and, for some specific frequency bands, in footnotes under article 5 of the 2004 edition) (see note) or in terms of maximum output power density fed to the antenna (e.g. footnote 5.482 for 10,6 GHz to 10,68 GHz band, footnote 5.522A for 18,6 GHz to 18,8 GHz band and footnote 5.557A for 55,78 GHz to 56,26 GHz band). Those limits shall be inclusive of tolerances and, if applicable, ATPC/RTPC influence.

NOTE: Testing EIRP requirements is necessary for assessment of equipment with integral antenna only; however also 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 guidance, in addition to the absolute maximum transmitter power, typical values of transmitter highest power for real equipment, of feeder loss and length, and of antenna diameter and gain are provided in TR 102 243-1 [i.27] in order to support inter- and intra- compatibility and sharing analysis.

In some frequency bands, or parts of frequency bands, ITU-R Recommendations define specific limits in terms of output power and/or EIRP (or output power and/or EIRP density) in order to improve the compatibility with other Radio Services sharing these frequency bands with the FS.

4.2.2 Transmitter power and frequency control

4.2.2.1 Transmitter Power Control (ATPC and RTPC)

Automatic Transmit Power Control (ATPC) and Remote Transmit Power Control (RTPC) are commonly optional features.

ATPC and RTPC functions are usually implemented through an attenuator inserted along the transmitting chain (e.g. at IF or at RF level or at both levels) and can be realized in a mixed configuration, e.g.:

- ATPC only is implemented;
- RTPC only is implemented;
- ATPC + RTPC are implemented with separate attenuator functions;
- ATPC + RTPC are implemented with a single attenuator supplying both functions.

4.2.2.1.1 Automatic Transmit Power Control (ATPC)

ATPC is an optional feature. Equipment with ATPC will be subject to a supplier's declaration of ATPC ranges (see note) and related tolerances. The supplier shall also declare if the equipment is designed with ATPC as a fixed permanent feature.

The equipment shall comply with the requirements of spectrum masks in clause 4.2.4 with ATPC operating in the range between maximum nominal power and maximum available power (see note) including the attenuation introduced by RTPC function (if any).

NOTE: For the relevant power level definitions of ATPC operation see EN 302 217-1 [6] while for additional clarification on ATPC and RTPC requirements see annex I. General background for ATPC operation may also be found in annex G of EN 302 217-2-1 [i.24].

4.2.2.1.2 Remote Transmit Power Control (RTPC)

Equipment with RTPC will be subject to a supplier's declaration with respect to RTPC ranges and related tolerances.

The equipment shall comply with the requirements of spectrum masks in clause 4.2.4 throughout the RTPC range.

NOTE: For additional clarification on ATPC and RTPC requirements see annex I.

4.2.2.2 Remote Frequency Control (RFC)

This functionality is an optional feature.

Equipment with RFC will be subject to a supplier's declaration of RFC ranges and related change frequency procedure.

RFC setting procedure shall not produce emissions outside of the previous and the final centre frequency spectrum masks required in clause 4.2.4.

4.2.3 Transmitter power tolerance

The nominal transmitter power shall be declared by the supplier.

The tolerance of the nominal transmitter power shall be within ±B dB, within the environmental profile declared by the supplier for the intended limits of usage of the equipment; the value of B is given in the relevant annex(es).

The test methods and conditions of transmitter power tolerance are specified in clause 5.2.3.

4.2.4 Radio Frequency (RF) spectrum mask

4.2.4.1 Limits background

The spectrum masks limits are necessary for a number of intra-system and inter-system regulatory and performance requirements.

The 0 dB level shown on the spectrum masks relates to the power spectral density at the carrier centre frequency, disregarding the residual of the carrier (due to modulation imperfection). The actual carrier frequency is identified with the f0 corner point (see note); spectrum masks are shown in frequencies relative to f0; the spectrum mask is assumed to be symmetrical with respect to the centre frequency f0.

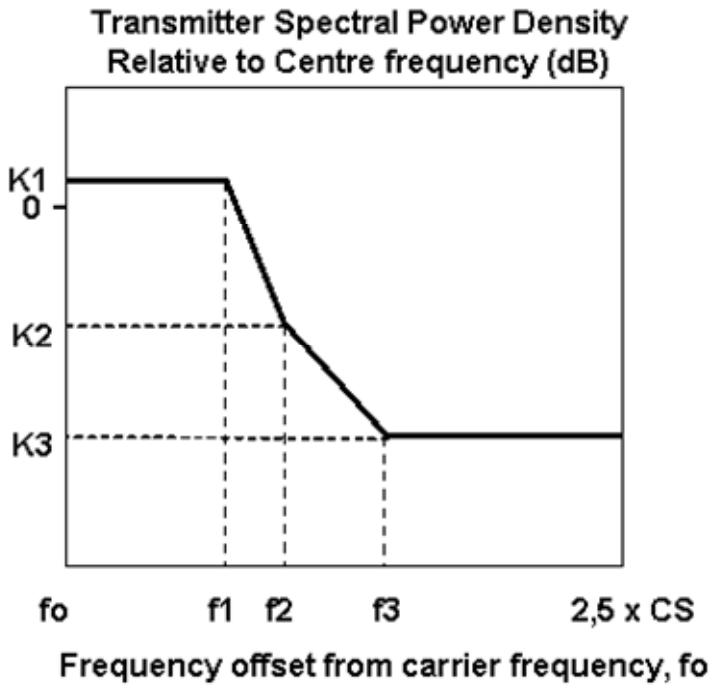
NOTE: The masks do not include frequency tolerance. Only systems specified in annex A are an exception to this general rule; in that case f0 identifies the nominal carrier frequency and the spectrum mask includes an allowance for the frequency tolerance.

Radio frequency spectrum mask limits have been reduced to a set of curves and a set of discreet points (i.e. fx MHz/Kx dB) identifying the frequency offset from f0 and the related attenuation; each curve is divided into a number of segments; each spectrum mask is then represented in the annexes by values located at discrete points on the relevant graph; the number of discreet points is dependent on the number of segments on the actual mask.

It is also assumed that the value associated with the final discreet point on the graph extends to a point equal to 2,5 times the channel separation (i.e. 2,5 × CS) on each side of the centre frequency.

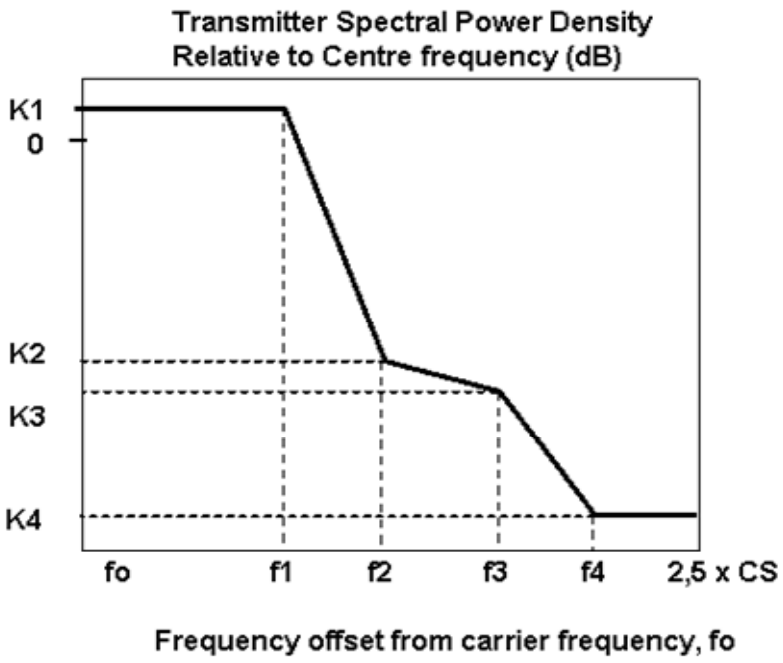
The following figures give the typical curves and their respective spectrum mask table representation. For all spectrum masks, the upper limit for frequencies is 2,5 × CS where CS is the channel separation.

The radio frequency spectrum mask is given in the relevant annex(es) with relevant corner points in table format.



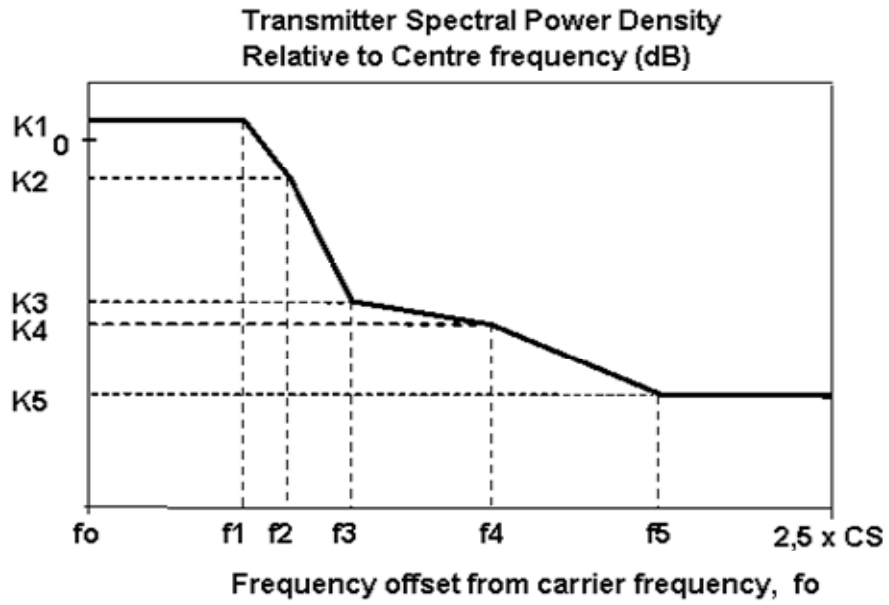
Number of segments	K1 in dB f1 in MHz	K2 in dB f2 in MHz	K3 in dB f3 in MHz
4	K1/f1	K2/f2	K3/f3

Figure 3: Four segment spectrum mask



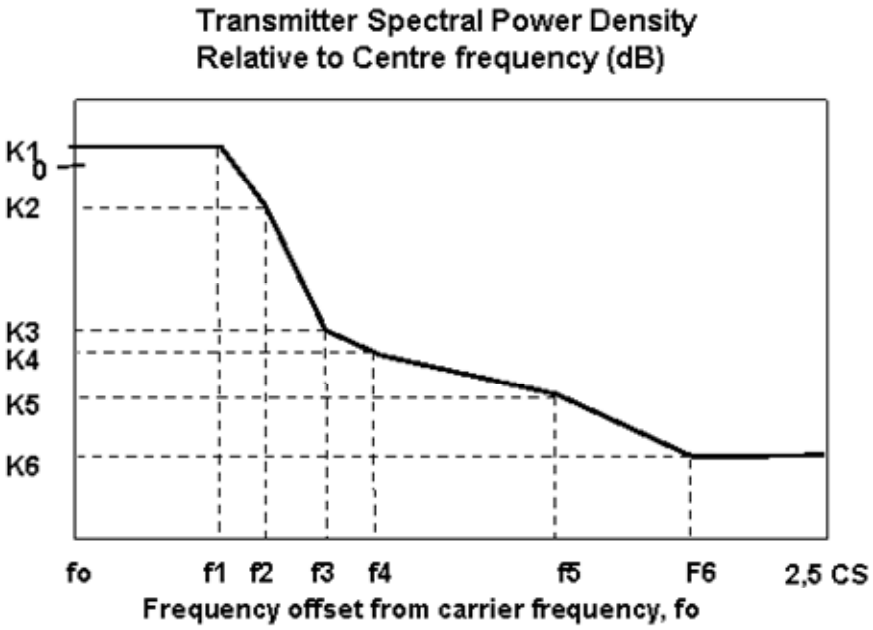
Number of segments	K1 in dB f1 in MHz	K2 in dB f2 in MHz	K3 in dB f3 in MHz	K4 in dB f4 in MHz
5	K1/f1	K2/f2	K3/f3	K4/f4

Figure 4: Five segment spectrum mask



Number of segments	K1 in dB f1 in MHz	K2 in dB f2 in MHz	K3 in dB f3 in MHz	K4 in dB f4 in MHz	K5 in dB f5 in MHz
6	K1/f1	K2/f2	K3/f3	K4/f4	K5/f5

Figure 5: Six segment spectrum mask



Number of segments	K1 in dB f1 in MHz	K2 in dB f2 in MHz	K3 in dB f3 in MHz	K4 in dB f4 in MHz	K5 in dB f5 in MHz	K6 in dB f6 in MHz
7	K1/f1	K2/f2	K3/f3	K4/f4	K5/f5	K6/f6

Figure 6: Seven segment spectrum mask

4.2.4.2 Limits

The relative power spectrum density mask, reported in the relevant annexes, shall be met.

For *preset-mode* systems, the manufacturer shall declare which combination of equipment spectral efficiency classes the equipment offers, within each ChS. For each spectral efficiency class the equipment shall be compliant with the relevant mask. The output power of the different classes shall be the nominal transmitted output power declared by the manufacturer for each class.

For *mixed-mode* systems, the manufacturer shall declare which combination of equipment spectral efficiency classes the equipment offers as *Reference Mode*, within each CS. For spectral efficiency class of each *Reference Mode* the equipment shall be compliant with the relevant mask (see note 1). The output power of the different classes shall be the nominal transmitted output power declared by the manufacturer for each *Reference Mode*.

NOTE 1: For *mixed-mode* systems, these requirements apply only for the assessment of essential requirements under article 3.2 of the R&TTE Directive [1]. It is assumed that, when operational, the system should be subject to different considerations, related to the *Reference Mode* used for co-ordination purpose; see clause I.3.

Mask attenuations beyond those set out in table 2 are not considered relevant to the essential requirements under article 3.2 of the R&TTE Directive [1] (see note 2).

NOTE 2: In previous ENs dealing with the same systems (see cross-reference in the introduction EN 302 217-1 [6]) there were some more stringent masks in relation to intra-system or local antenna system sharing compatibility requirements. The portion of mask exceeding the minimum requirement in table 2, has not been considered relevant to article 3.2 of R&TTE Directive [1] and is maintained, when appropriate, only as "additional ETSI voluntary characteristic" in EN 302 217-2-1 [i.24].

Table 2: Maximum spectrum mask attenuation relevant to the essential requirements under article 3.2 of the R&TTE Directive

Operating frequency band [GHz]	Maximum attenuation [dB]
f < 10	55 (see note)
10 GHz ≤ f < 17	55
17 GHz ≤ f < 30	50
f ≥ 30	45

NOTE: This value will affect the nodal efficiency (i.e. the minimum angle for links at a frequency distance of more than one channel converging into the same nodal station). In the past, when trunk systems with multichannel branching were mostly used, previous DFRS harmonized standard, which has now been superseded by the present document, required a tighter figure of 60 dB; however, here it is considered, for the benefit of the market, nowadays focused on more flexible systems, that the 55 dB figure represents an average requirement for most cases and a better compromise between design complexity and nodal efficiency. Nevertheless, provided that cases of very congested nodal area are not infrequent, Regulatory bodies, for the links converging to those nodal points and on a case by case basis, may limit the attenuation to the more stringent figure of 60 dB.
Administrations, specifying the more stringent option, will detail this requirement in the Interface Notification under article 4.1 of R&TTE Directive [1].
For this reason, in some cases, the relevant annexes will introduce two options for spectrum masks covering one or both requirements, equipment supplier may choose to produce and assess different products.

4.2.5 Discrete CW components exceeding the spectrum mask limit

4.2.5.1 Discrete CW components at the symbol rate

In case they exceed the spectrum mask, the power level (at reference point C' or at point B' if C' is not available) of spectral lines at a distance from the channel frequency equal to the symbol rate shall be more than 23 dB below the mean power level of the carrier for class 2,29 dB for class 3,37 dB for classes 4L, 4H, 5A and 6A, 43 dB for class 5B and 49 dB for class 6B.

4.2.5.2 Other discrete CW components exceeding the spectrum mask limit

Should CW components exceed the spectrum mask given in the relevant annexes, an additional allowance is given.

Those lines shall not:

- exceed the mask by a factor more than {10 log (CSmin/IFbandwidth) - 10} dB (see note);
- be separated in frequency by less than CSmin.

where CSmin is dependent on the frequency band and the system under consideration and is given in table 3.

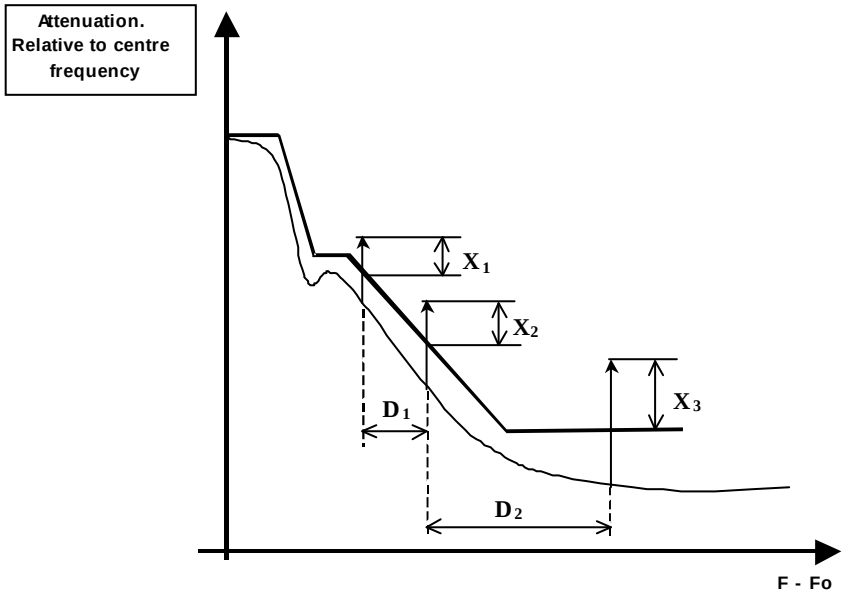
IF bandwidth is the recommended resolution bandwidth set out in table 6.

NOTE: In case the calculation of the allowance factor will result in a negative value, no additional allowance is then permitted.

Table 3: CSmin values for relevant bands

Frequency band/Channel separation	System annex reference	Csmin (MHz)
1,4 GHz/All channel separations	A.1	0,025
2,4 GHz/All channel separations	A. 2	0,5
3,4 GHz to 3,8 GHz/Channel separations ≤ 14 MHz	B.1	0,5
3,6 GHz to 4,2 GHz/Channel separations > 14 MHz	B (all systems) and C (all systems)	10
U4 GHz/All channel separations	B (all systems) and C (all systems)	10
L6 GHz/All channel separations	B (all systems)	14,825
U6 GHz/All channel separations	B (all systems) and C (all systems)	10
7 GHz and 8 GHz/All channel separations	B (all systems) and C (all systems)	7
10 GHz/All channel separations	B.1	1,5
11 GHz/All channel separations	B.1 and C (all systems)	10
13 GHz and all bands above/All channel separations	D (all systems), E (all systems)	1,75

Figure 7 shows a typical example of this requirement.



X_1, X_2, X_3 [dB] $\leq 10\log(CSmin/IFbw) - 10$

$D_1, D_2 \geq CSmin$

Figure 7: CW lines exceeding the spectrum mask (typical example)

4.2.6 Spurious emissions - external

It is necessary to define spurious emissions (or more precisely, according latest ITU-R definitions, unwanted emissions in the spurious domain) from transmitters in order to limit interference into other systems operating wholly externally to the system under consideration (external emissions). Limits are set out by EN 301 390 [5].

The equipment shall comply with the requirements of clause 4.1 of EN 301 390 [5] for any setting of ATPC and RTPC (if any).

NOTE 1: ERC/REC 74-01 [2] based on ITU-R Recommendations SM.329 [i.48], and ITU-R Recommendation F.1191-2 [i.44] give the applicable definitions.

NOTE 2: EN 301 390 [5] includes, for P-P systems, the same limits of ERC/REC 74-01 [2].

The limits are applicable at reference point C' or at point B' if C' is not available.

4.2.7 Dynamic Change of Modulation Order

For *mixed-mode* systems, the transient behaviour of the transmitter, when a transition from any modulation format offered to any other occurs, shall meet the specification for the spectrum density mask (note) and its associated CW spectral lines allowance (see clause 4.2.5) of the declared *Reference-mode* (reference spectral efficiency class) applicable for a relevant ChS.

In this case, the spectrum density mask, shall be referenced to the absolute levels obtained with the reference mode in static conditions (i.e. the dynamic operation shall not exceed the absolute power of the reference mode).

The supplier shall declare, for each ChS, among the number of possible equipment classes, the possible *Reference-modes* (possibly used for licensing procedures) the system is capable to fulfil. For each reference mode, the supplier shall define the corresponding equipment settings for meeting the requirements (e.g. spectrum mask) of this *reference-mode*. See also clause I.3.

Such dynamic transitions shall also not cause the specifications for spurious emissions (see clause 4.2.6) to be exceeded.

4.2.8 Radio frequency tolerance

For the purpose of the present document the frequency tolerance is as defined in Art 1.151 of the Radio Regulations [10] as "*The maximum permissible departure by the centre frequency of the frequency band occupied by an emission from the assigned frequency*".

The maximum allowable RF frequency tolerance shall not exceed, by any reason, ±X ppm or ±YY kHz, whichever is the more stringent, for operation in environmental profile declared by the supplier.

The values are system dependent and are given in the relevant annexes A to E. The supplier shall declare the values of the nominal carrier frequencies.

For conformity test purpose the supplier shall state the guaranteed short-term part and the expected ageing part.

4.3 Receiver requirements

All measurements, when applicable, shall be carried out with the transmitters loaded with test signals defined in clause 4.2.

4.3.1 Spurious emissions - external

It is necessary to define spurious emissions (or more precisely, according latest ITU-R definitions, unwanted emissions in the spurious domain) from receivers in order to limit interference into other systems operating wholly externally to the system under consideration (external emissions); those limits are set out in EN 301 390 [5]. Those limits are applicable at reference point C or at point B if C is not available.

NOTE 1: ERC/REC 74-01 [2] based on ITU-R Recommendations SM.329 [i.48], and ITU-R Recommendation F.1191 [i.44] gives the applicable definitions.

NOTE 2: EN 301 390 [5] includes, for P-P systems, the same limits as ERC/REC 74-01 [2].

4.3.2 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 shall be transformed into FER requirements according to the rules given in clause G.3.

The supplier shall declare the RSL threshold(s) (dBm) for the relevant BER values (i.e. 10^{-6} and 10^{-8} or 10^{-10}), which shall not be worse than the corresponding RSL upper bound values indicated in the tables of the relevant annex(es).

Equipment working at the relevant declared RSL thresholds shall produce a BER equal to or less than the corresponding values (i.e. 10^{-6} and 10^{-8} or 10^{-10}).

NOTE 1: For *mixed-mode* systems, these requirements apply only for the assessment of essential requirements under article 3.2 of the R&TTE Directive [1]. It is assumed that, when operational, the switchover among different modes will happen at suitable RSL thresholds defined by the manufacturer or the operator. See clause I.3.

NOTE 2: It should be noted that, in previous ENs for PP systems, figures of RSL for a BER $\leq 10^{-3}$ were also standardized. However, in line with the present network requirements for high quality data transport, this BER is no longer representative for a unique performance and availability assessment and therefore is no longer considered relevant to essential requirements under article 3.2 of R&TTE Directive [1]. Actual RSL threshold for link budget definition may be defined by the supplier, generally set to a BER between 10^{-6} and 10^{-3}, according to the type of traffic and quality of service to be provided.

4.3.3 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. There are different requirements for "internal" interference given by the cross polar transmitters in systems implementing XPIC for CCDP operation; however, the latter requirements are not considered relevant to essential requirements under article 3.2 of R&TTE Directive [1] and are set out in EN 302 217-2-1 [i.24].

All Carrier to Interference ratio (C/I) measurements are referred to reference point C (for systems for single channel applications) or B (for systems with multi-channel branching system).

The values are indicated in the annexes A to E.

The limits of Carrier to Interference ratio (C/I) in case of co-channel and adjacent channel interference shall be as specified in the relevant tables of annexes A to E, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits declared by the supplier for a BER $\leq 10^{-6}$ in clause 4.3.2.

The format of such tables is given in table 4.

NOTE: For equipment in annex A only 1 dB degradation is required. In some cases a requirement for second adjacent channel interference is also given.

For adjacent channel interference, the requirement shall be met independently on upper and lower adjacent interference.

Table 4: Co-channel and 1st adjacent channel interference sensitivity table format

				C/I for BER ≤ 10^{-6} RSL degradation of 1 dB or 3 dB			
				Co-channel Interference		adjacent channel interference	
Spectrum efficiency class	System	Nominal bit rate (Mbit/s)	Channel separation (MHz)	1 dB	3 dB	1 dB	3 dB
NOTE: Actual values for this template are found in annexes A to E.							

4.3.4 CW spurious interference

For a receiver operating at the RSL declared by the supplier in clause 4.3.2 for a BER $\leq 10^{-6}$ threshold, the introduction of a CW interferer at a level specified by EN 301 390 [5], 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 [5], but excluding frequencies either side of the wanted frequency by up to 250 % of the separation between channels 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 this EN 302 217 series.

4.4 Antenna directional requirements

This clause is relevant for all equipment specified in annexes A to F when an integral antenna is provided. Stand alone antenna products are covered, for the relevant frequency band and antenna class, by EN 302 217-4-2 [7].

However, with integral antennas, it may be possible to test the antenna separately from the equipment (see note); in this case the declaration of conformity may be composed of a declaration of conformity for the equipment and a declaration of conformity for the antenna, done separately by the actual supplier(s), according to EN 302 217-4-2 [7].

NOTE: Using special tool supplied by the supplier.

RPE, gain (including tolerances around the nominal declared value) and XPD of antennas are essential requirements for equipment with integral antennas, but not only for the transmitter side. Since receiver parameters are essential for the Fixed Service, in the case of receive only antenna (e.g. in space diversity applications) antenna parameters are as essential on the receive side as they are on the transmitter side. Antenna essential requirements are then described without any reference to transmit or receive side.

4.4.1 Radiation Pattern Envelope (Off-axis EIRP density)

In the case of radio equipment with an integral antenna and where applicable, the Radiation Pattern Envelope (off-axis EIRP density) is essential under article 3.2 of the R&TTE Directive [1]; limits are set out in clause 4.2 of EN 302 217-4-2 [7].

4.4.2 Antenna gain

In the case of radio equipment with an integral antenna and where applicable, the antenna gain is essential under article 3.2 of the R&TTE Directive [1]; limits are set out in clause 4.4 of EN 302 217-4-2 [7].

4.4.3 Antenna Cross-Polar Discrimination (XPD)

In the case of radio equipment with an integral antenna and where applicable, the antenna cross-polar discrimination (XPD) is essential under article 3.2 of the R&TTE Directive [1]; limits are set out in clause 4.3 of EN 302 217-4-2 [7].

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

The equipment shall comply with all the requirements of the present document at all times when operating within the boundary limits of the operational environmental profile declared by the supplier, including the limits of any primary/secondary power supply external to the equipment under assessment.

Boundary limits of environmental climatic conditions, which are part of the environmental profile, may be determined by the environmental class of the equipment according to the guidance given in clause 4.4 of EN 301 126-1 [3].

Tests defined in the present document shall be carried out at representative points 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 with respect to 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 [3] for climatic conditions and in table 1 of EN 301 126-1 [3] and clauses 5.2 and 5.3 of the present document for power supply conditions. The requirement to test at reference or extreme conditions is set out in clauses 5.2 and 5.3 of the present document according to the principles for similar requirements set out in EN 301 126-1 [3].

b) For integral DFRS antennas (directional phenomena of clause 4.4 of the present document), at reference environmental conditions of the test field according to clause 4.1 of EN 301 126-3-1 [4].

The test report shall be produced according to the procedure set out in article 10 of the R&TTE Directive [1].

Interpretation of the results recorded in a test report (of the measurements described in the present document) shall be as follows:

- For the purposes of test, the limits in the present document are based on the "shared risk" of measurement uncertainty, e.g. if a measurement meets the requirements of the standard, even if it is within the calculated measurement uncertainties, it shall be deemed compliant with the measurement parameter.

- If it fails to meet the requirements of a standard, even within measurement uncertainty, it is deemed to be not compliant with the measurement parameter.

Measurement uncertainty calculations should be based on the latest available ETSI guidelines.

In conclusion:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;

- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report.

5.2 Essential radio test suites for the transmitter

The tests, carried out to generate the test report and/or declaration of conformity in order to fulfil any conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out at climatic conditions referred to in table 5 and, when applicable for equipment with integral antenna, in table 8.

Table 5 indicates the different clauses applicable, for a given parameter, to the requirement, the test clause in the present document and the corresponding test method in the base test document EN 301 126-1 [3].

Table 5: Transmitter parameters, test clauses and conditions

Clause (see note 2)	Parameter (see note 2)	EN 301 126-1 [3] reference clause for the test methods	Climatic conditions (see note 1)		Channels to be tested (see note 4)	Other specific conditions
			Ref	Extreme	B = Bottom M = Middle T = Top	
5.2.1	**Transmitter power range**	5.2.1	X	X	BMT	See note 3
5.2.2	**Transmitter power and frequency control**					
5.2.2.1.1	**Automatic Transmit Power Control (ATPC)**	5.2.3 and 5.2.6	X		M	
5.2.2.1.2	**Remote Transmit Power Control (RTPC)**	5.2.4 and 5.2.6	X		BMT	Shall be carried out at three operating conditions (lowest, medium, and highest delivered power) of the RTPC power range and with ATPC (if any) set to maximum nominal power
5.2.2.2	**Remote Frequency Control (RFC)**	5.2.7 and 5.2.6	X		BMT	Tests shall be carried for RFC setting procedure for three frequencies (i.e. frequency settings from lower to centre, centre to higher and back to the lower frequency within the covered range)
5.2.3	**Transmitter power tolerance**	5.2.1	X	X	BMT	See note 3
5.2.4	**RF Spectrum Mask**	5.2.6	X	X	BMT	See note 3
5.2.5	**Discrete CW components exceeding the spectrum masks limits**	5.2.8	X	X	BMT	See note 3
5.2.6	**Spurious emissions-external**	5.2.9	X		BMT	The tests shall be carried out with ATPC, if any, set to maximum available power and RTPC, if any, set at minimum attenuation. Actual test shall be limited to the practical frequency range set out by clause A.1 of EN 301 390 [5]
5.2.7	**Dynamic Change of Modulation Order**	-	X	X	BMT	See note 3 Required for *mixed-mode* systems only, according clause 5.2.7 of the present document Test at extremes of temperature limited to spectrum mask and CW components assessment
5.2.8	**Radio frequency tolerance**	5.2.5	X	X	BMT	See note 3

NOTE 1: This refers to climatic conditions only; for other environmental and power supply conditions, please refer to EN 301 126-1 [3], which provides, for testing some parameters, combined variations also of the power supply source, see table 1 of EN 301 126-1 [3]; however, DC regulators on all the DC sources actually used for carrier generation are commonly integral to the radio equipment. When this is the case, such additional tests are considered redundant and not necessary to assess the compliance to the essential requirements of article 3.2 of the R&TTE Directive [1]. This will not imply any reduction to the supplier responsibility related to the conformance declaration, which, in any case, shall be valid for the whole declared environmental profile.

NOTE 2: For equipment with integral antennas, the essential transmitter test suite clauses include the antenna parameters, test clauses and conditions contained in table 8, clause 5.4.

NOTE 3: This clause requires, besides extremes of temperature, testing also at extremes of voltage (see note 1).

NOTE 4: Annex G provides more detailed information on channels to be tested, depending on the type of equipment.

5.2.1 Transmitter power

Test methods for the transmitter power and transmitter power tolerance shall be in accordance with clause 5.2.1 of EN 301 126-1 [3].

5.2.2 Transmitter power and frequency control

5.2.2.1 Transmitter Power Control (ATPC and RTPC)

5.2.2.1.1 ATPC

The correct operation of the ATPC function (according to the supplier's declaration) shall be tested according to the test method described in clause 5.2.3 of EN 301 126-1 [3].

Testing shall be carried out with transmitter power level corresponding to:

- ATPC set manually to a fixed value for receiver requirements (clause 4.2.2.1.1);
- ATPC set at maximum available power for transmitter requirements (clause 4.2.1).

The test shall be carried out at reference climatic conditions.

5.2.2.1.2 RTPC

The tests, carried out to generate the test report and/or declaration of conformity, required in order to fulfil any Conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out at three operating conditions (lowest, medium, and highest delivered power) of the RTPC power range and with ATPC (if any) set to maximum nominal power. The test shall be carried out at reference and extreme climatic conditions.

Even if all the procedures set out in clause 5.2.6 of EN 301 126-1 [3] are followed, the actual tests, at the lower RTPC power levels, may fall outside of the available sensitivity of test instruments currently available on the market. In this event the supplier shall produce an attachment to the test report containing:

- calculated evidence that the noise floor of the actual test bed is higher than the mask requirement;
- calculated evidence that the actual noise floor, generated by the transmitter with respect to the noise figure and implemented amplification/attenuation chain, is lower than the mask requirement.

Tests for other transmit and receive requirements shall be made with RTPC set at highest delivered power.

5.2.2.1.3 Remote Frequency Control (RFC)

Test methods for the remote frequency control shall be in accordance with clause 5.2.7 of EN 301 126-1 [3].

5.2.3 Transmitter power tolerance

Test methods for the transmitter power tolerance shall be in accordance with clause 5.2.1 of EN 301 126-1 [3].

5.2.4 RF spectrum mask

Test methods for the RF spectrum masks shall be in accordance with clause 5.2.6 of EN 301 126-1 [3].

NOTE: The required values may be evaluated by adding a measured filter characteristic to the spectrum measured at reference point A' of figure 1 of EN 302 217-1 [6]. Due to the limitations of some spectrum analysers, difficulties may be experienced when testing high capacity/wideband systems. In this event, the following options are to be considered: measurement using a high performance spectrum analyser; use of a notch filter; two step measurement technique. When difficulties are experienced, the plots of one test may be produced as evidence of conformance to the spectrum mask.

Table 6 shows the recommended spectrum analyser settings.

Table 6: Spectrum analyser settings for RF power spectrum measurement

Channel separation (CS) (MHz)	0,003 < CS ≤ 0,03	0,03 < CS ≤ 0,3	0,3 < CS ≤ 0,9	0,9 < CS ≤ 12	12 < CS ≤ 36	36 < CS
Centre frequency	fo					
Sweep width	> 5 × CS					
Scan time	Auto					
IF bandwidth (kHz)	1	3	10	30	100	300
Video bandwidth (kHz)	0,03	0,1	0,1	0,3	0,3	0,3
NOTE: fo represents either the nominal channel centre frequency (for systems in annex A) or the actual carrier frequency (for systems in all annexes B to E).						

5.2.5 Discrete CW components exceeding the spectrum mask limit

Test methods for the discrete CW lines exceeding the spectrum mask shall be in accordance with clause 5.2.8 of EN 301 126-1 [3].

5.2.6 Spurious emissions - external

Test methods for spurious emissions shall be in accordance with clause 5.2.9 of EN 301 126-1 [3]. The test shall be limited to the practical frequency ranges specified in clause A.1 of EN 301 390 [5]. The test shall be carried out at reference climatic conditions.

5.2.7 Dynamic Change of Modulation Order

For *mixed-mode* systems only; this test shall be carried out for transient behaviour with the spectrum analyser in "max hold" mode. The equipment shall be configured to operate with continuous sequence of modulation mode switching at the maximum switching speed permitted by the system, with equal duty cycle for all modulation orders; each modulation format shall be associated with its maximum rated power defined for not exceeding the "*reference-mode*" emission limitations.

In this case, the spectrum density mask, shall be referenced to the absolute levels obtained with the reference mode in static conditions (i.e. the dynamic operation shall not exceed the absolute power of the reference mode).

All dynamic operation and control signals shall be active and modulated as in normal operation. The reference-mask shall be applied to the maximum spectral density in the "max-hold" condition, disregarding, if any, residual of the carrier due to modulation imperfection.

5.2.8 Radio frequency tolerance

Test methods for the radio frequency tolerance shall be in accordance with clause 5.2.5 of EN 301 126-1 [3].

5.3 Essential radio test suites for the receiver

The tests, carried out to generate the test report and/or declaration of conformity in order to fulfil any conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out at reference and extreme climatic conditions according to the provisions for each test summarized in table 7; these tests will be carried out at nominal power supply conditions only. For each parameter table 7 gives the applicable clauses for the requirement, for the test clause in the present document, for the corresponding clause in EN 301 126-1 [3] and comments on climatic and other specific conditions.

Receiving phenomena tests are considered without the option of space diversity. However, in the case of diversity applications, they do apply separately to any receiver.

For receiving phenomena, the tests, required to generate the test report and/or declaration of conformity in order to fulfil any conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out with ATPC, if any, set to either automatic or maximum nominal power operation and RTPC, if any, set to an arbitrary value chosen by the supplier. The supplier will select the appropriate condition according to the actual implementation on the equipment.

Table 7: Essential receiver test suite clauses

Clause (see note 2)	Parameter (see note 2)	EN 301 126-1 [3] reference clause for test methods	Climatic conditions (see note 1)		Channels to be tested (see note 4)	Other specific conditions (see note 3)
			Ref	Extreme	B = Bottom M = Middle T = Top	
5.3.1	Spurious emissions - external	5.3.2	X		BMT	Actual test shall be limited to the practical frequency range specified by clause A.1 of EN 301 390 [5]
5.3.2	BER as a function of receiver input signal level (RSL)	5.3.3.1	X	X	BMT at Nominal M at Extreme	
5.3.3	Co-channel "external" interference sensitivity	5.3.3.2	X		M	
5.3.4	Adjacent channel interference sensitivity	5.3.3.3	X		M	To be produced for the lower or for the upper frequency adjacent channel, arbitrarily selected by supplier
5.3.5	CW spurious interference	5.3.3.4	X		M	Actual test shall be limited to the practical frequency range specified by clause 7.1 of EN 301 390 [5]

NOTE 1: This refers to climatic conditions only; for other environmental and power supply conditions, please refer to EN 301 126-1 [3].
NOTE 2: For receiving equipment with integral antennas, the essential receiver test suite clauses include the antenna parameters, test clauses and conditions contained in table 8, clause 5.4.
NOTE 3: All receiver test suite clauses are performed at nominal voltage only.
NOTE 4: Annex G provides more detailed information on channels to be tested, depending on the type of equipment.

5.3.1 Spurious emissions - external

The test shall be limited to the practical frequency ranges specified by clause A.1 of EN 301 390 [5]. The test shall be carried out at reference climatic conditions. Test methods shall be in accordance with clause 5.3.2 of EN 301 126-1 [3].

5.3.2 BER as a function of receiver input signal level (RSL)

Test methods of the BER as a function of receiver input signal level RSL shall be in accordance with clause 5.3.3.1 of EN 301 126-1 [3].

In the case of a multi-interface, multi-carrier system, annex G shall apply.

5.3.3 Co-channel "external" and adjacent channel interference sensitivity

Test methods for co-channel interference sensitivity shall be in accordance with clause 5.3.3.2 of EN 301 126-1 [3].

Test methods for adjacent channel interference sensitivity shall be in accordance with clause 5.3.3.3 of EN 301 126-1 [3].

The tests shall be carried out at reference climatic conditions. The test will be produced for the lower or for the upper frequency adjacent channel, arbitrarily selected by the supplier.

5.3.4 CW spurious interference

Test methods for CW spurious interference shall be in accordance with clause 5.3.3.4 of EN 301 126-1 [3]. The test shall be limited to the practical frequency ranges specified in clause 7.1 of EN 301 390 [5]. The test shall be carried out at reference climatic conditions.

5.4 Additional essential antenna test suites for systems with integral antenna

Table 8: Transmitter/receiver antenna parameters, test clauses and conditions

Clause	Parameter	EN 301 126-3-1 [4] reference clause for test methods	Climatic conditions (see note 1)		Frequency to be tested (see note 2)	Other specific conditions
			Reference	Extreme	B = Bottom T = Top	
5.4	Antenna directional requirements					
5.4.1	Radiation Pattern Envelope (RPE) (Off-axis EIRP density)	6.1	X		BT	
5.4.2	Antenna gain	6.3	X		BT	
5.4.3	Antenna Cross-Polar Discrimination (XPD)	6.2	X		BT	
NOTE 1: This refers to climatic conditions only; for other environmental conditions, please refer to EN 301 126-3-1 [4]. NOTE 2: For more detailed information on frequency to be tested for wideband antennas, see EN 302 217-4-2 [7].						

5.4.1 Radiation Pattern Envelope (Off-axis EIRP density)

Test methods for the Radiation Pattern Envelope (RPE) shall be in accordance with clause 6.1 of EN 301 126-3-1 [4].

5.4.2 Antenna gain

Test methods for the antenna gain shall be in accordance with clause 6.3 of EN 301 126-3-1 [4].

5.4.3 Antenna Cross-Polar Discrimination (XPD)

Test methods for the Antenna Cross-Polar Discrimination shall be in accordance with clause 6.2 of EN 301 126-3-1 [4].

Annex A (normative): Frequency bands from 1,4 GHz to 2,7 GHz

A.1 Introduction

The following point-to-point Digital Fixed Radio Systems are covered in this annex:

- A.1 : Low capacity point-to-point digital radio systems operating in the 1,4 GHz frequency band.
- A.2 : Low and medium capacity point-to-point digital radio systems operating in the frequency range 2,1 GHz to 2,6 GHz.

A.2 General characteristics

A.2.1 Frequency characteristics and channel arrangements

In the following table, ITU-R and ECC (formerly CEPT/ERC) recommended frequency channel arrangements, known at the date of publication of the present document, are set out for reference only. The channel arrangement in itself is not relevant with respect to article 3.2 requirements; only the frequency band and actual channel separation is relevant for defining the set of parameters and test suites for each system mainly designed for that channel separation.

Other national or future ITU-R or ECC recommendations set around the rough boundary of present ITU-R or ECC recommendations are considered applicable to systems assessed against the present document, provided that they use the same channel separation.

For assessment of wide-band coverage systems see annex G.

Table A.1: Frequency characteristics

Band (GHz)	Frequency range (MHz)	Channel separation (MHz)	Applicable to system	Recommendations for radio frequency channel arrangements	
				ECC (CEPT/ERC) (see note)	ITU-R (see note)
1,4	1 350 to 1 375 paired with 1 492 to 1 517	0,025 to 3,5	A.1	T/R 13-01 annex A [i.19]	-
1,4	1 375 to 1 400 paired with 1 427 to 1 452	0,025 to 3,5	A.1	T/R 13-01 annex B [i.19]	-
2,1	2 025 to 2 110 paired with 2 200 to 2 290	0,5 to 14	A.2	T/R 13-01 annex C [i.19]	-
2,6	2 520 to 2 593 paired with 2 597 to 2 670	0,5 to 14	A.2	T/R 13-01 annex D [i.19]	-
2,4	2 300 to 2 500	1 and 2	A.2	-	F.746-9 annex 1 [i.39]
NOTE: All ECC (CEPT/ERC), or ITU-R Recommendations listed in this clause are referred to in clause 2.2.					

A.2.2 Transmission capacities

Digital systems covered by this annex are intended to be used for point-to-point connections in local and regional networks.

- System A.1 Typical base band data rates are between 9,6 kbit/s and 4 × 2 Mbit/s.
- System A.2 Typical base band data rates are N × 64 kbit/s, N × 2 Mbit/s (N = 1, 2, 4, 8, 16), 2 × 8 Mbit/s and 34 Mbit/s.

The indicative channel capacities (gross bit rate), shown in table A.2 for the three classes of equipment, are based on the maximum gross bit rate for the minimum modulation level in each class. It is possible to improve on the gross bit rate by using higher modulation schemes within each class. The use of higher modulation levels within each class is permitted so long as the limits of the relevant spectral power density mask are not exceeded.

Table A.2: Indicative channel capacities (gross bit rate), for ACCP operation

System	Channel separation	Class 1 equipment	Class 2 equipment	Classes 4L or 4H equipment
A.1	25 kHz	20 kbit/s	32 kbit/s	64 kbit/s
A.1	75 kHz	60 kbit/s	95 kbit/s	190 kbit/s
A.1	250 kHz	200 kbit/s	325 kbit/s	650 kbit/s
A.1 and A.2	500 kHz	400 kbit/s	650 kbit/s	1 300 kbit/s
A.1 and A.2	1 MHz	800 kbit/s	1 300 kbit/s	2 600 kbit/s
A.2	1,75 MHz	1 400 kbit/s	2 275 kbit/s	4 550 kbit/s
A.1 and A.2	2 MHz	1 600 kbit/s	2 600 kbit/s	5 200 kbit/s
A.1 and A.2	3,5 MHz	2 800 kbit/s	4 500 kbit/s	9 100 kbit/s
A.2	7 MHz	Not applicable	9 000 kbit/s	18 200 kbit/s
A.2	14 MHz	Not applicable	18 000 kbit/s	38 000 kbit/s

The capacities in table A.2 are commonly tailored to typical medium and low speed data interface, PDH and sub-STM-0 SDH rates can be accommodated as appropriate. For equipment assessment when other base band interfaces or a combination of them are foreseen see annex F.

A.3 Transmitter

A.3.1 General requirements

Table A.3: Transmitter requirements

Requirements	System	
	A1	**A2**
Maximum transmitter power	Clause 4.2.1	
Nominal transmitter power tolerance	B = +2 dB/-1 dB	
Transmitter power and frequency control	Clause 4.2.2	
RF spectrum mask	RF spectrum density mask in clause A.3.2	
Discrete CW components exceeding the spectrum mask limit: spectral lines at the symbol rate and other spectral lines	Clause 4.2.5	
Spurious emissions-external	Clause 4.2.6	
Radio frequency tolerance	No specific value is requested, however, Radio frequency tolerances shall be included in the spectrum mask values given below. They include tuning accuracy and environmental effects as well as long term ageing (see note)	
NOTE: For conformance procedure, the supplier should state the portion of frequency tolerance to be taken into account for the long term ageing; the mask frequency points will be reduced accordingly.		

A.3.2 Spectrum mask

Spectrum masks are inclusive of an allowance for radio frequency tolerance. Centre frequency f0 identifies the nominal carrier frequency; the mask shall be extended up to 2,5 times the relevant CS of each system.

Table A.4, with reference to the relevant generic mask shape specified in clause 4.2.4.1, shows the offset frequency from f0 and attenuation of other corner points of the spectrum mask.

Table A.4: Limits of transmitter spectral power density as a function of channel separation

System	Spectrum efficiency class	Channel separation (MHz)	K1 (dB)	f1 (kHz)	K2 (dB)	f2 (kHz)	K3 (dB)	f3 (kHz)	K4 (dB)	f4 (kHz)
A.1	1 and 2	0,025	+3	12	-25	18	-25	25	-45	40
		0,075		36		54		75		120
		0,250		110		170		230		400
A.1 and A.2		0,500		210		325		450		800
		1		420		650		900		1 600
		2		840		1 300		1 800		3 200
		3,5		1 500		2 400		3 500		6 000
A.2		1,75		750		1 150		1 600		2 800
		7		3 000		4 800		7 000		12 000
		14		6 000		9 600		14 000		24 000
A.1	4	0,025	+1	12	-32	18	-32	25	-55	40
		0,075		36		54		75		120
		0,250		110		170		230		400
A.1 and A.2		0,500		210		325		450		800
		1		420		650		900		1 600
		2		840		1 300		1 800		3 200
		3,5		1 500		2 400		3 500		6 000
A.2		1,75		750		1 150		1 600		2 800
		7		3 000		4 800		7 000		12 000
		14		6 000		9 600		14 000		24 000
NOTE: For mask reference shape see figure 4.										

A.4 Receiver

A.4.1 General requirements

Table A.5: Receiver requirements

Requirements	System	
	A.1	A.2
Spurious emissions (External)	Clause 4.3.1	
BER as a function of RSL	Table A.6	
Co-channel "external" and adjacent interference sensitivity	Table A.7	
CW spurious response	Clause 4.3.4	

A.4.2 BER as a function of receiver input signal level (RSL)

The supplier shall declare the RSL threshold(s) (dBm) for BER $\leq 10^{-6}$, which shall not be worse than the corresponding RSL upper bound values indicated in table A.6. The declared Receiver Signal Levels (RSL) shall produce a BER $\leq 10^{-6}$.

Table A.6: Receiver BER as a function of receiver input signal level RSL (upper bound)

Spectrum efficiency class	System	Co-polar channel separation	RSL for BER ≤ 10^{-6} (dBm) (Note 1)
1 (Note 2)	**A.1**	25 kHz	-105
	A.1	75 kHz	-100
	A.1	250 kHz	-94
	A.1 and A.2	500 kHz	-92
	A.1 and A.2	1 MHz	-89
	A.2	1,75 MHz	-87
	A.1 and A.2	2 MHz	-86
	A.1 and A.2	3,5 MHz	-83
2	**A.1**	25 kHz	-108
	A.1	75 kHz	-103
	A.1	250 kHz	-97
	A.1 and A.2	500 kHz	-95
	A.1 and A.2	1 MHz	-92
	A.2	1,75 MHz	-90
	A.1 and A.2	2 MHz	-89
	A.1 and A.2	3,5 MHz	-86
	A.2	7 MHz	-83
	A.2	14 MHz	-80
4	**A.1**	25 kHz	-101
	A.1	75 kHz	-97
	A.1	250 kHz	-91
	A.1 and A.2	500 kHz	-89
	A.1 and A.2	1 MHz	-86
	A.2	1,75 MHz	-84
	A.1 and A.2	2 MHz	-83
	A.1 and A.2	3,5 MHz	-80
	A.2	7 MHz	-77
	A.2	14 MHz	-74

NOTE 1: For these systems, only RSL for BER ≤ 10^{-6} is standardized; however, in previously published ENs these systems were also required to meet a specific RSL for BER ≤ 10^{-3}, which were set 4 dB lower than the RSL for BER ≤ 10^{-6}. This figure, given here for information only, may be used for deriving a typical RSL versus BER curve.

NOTE 2: Class 1 equipment performances are based on simpler receiver/demodulator implementation and modulation formats (e.g. FSK); this justify their limits worse than those of class 2 equipment.

A.4.3 Co-channel "external" and adjacent channels interference sensitivity

The limits of Carrier to Interference ratio (C/I), in case of co-channel, first and second adjacent channel interference, shall be as set out in table A.7, giving maximum C/I values for 1 dB degradation of the RSL limits declared for BER $\leq 10^{-6}$ in clause A.4.2.

Table A.7: Co-channel and adjacent channels interference sensitivity

Spectrum efficiency class	Channel separation (MHz)	C/I (dB) for BER ≤ 10^{-6} RSL degradation of 1 dB		
		Co-channel interference C/I (dB)	First adjacent channel interference C/I (dB)	Second adjacent channel interference C/I (dB)
1	**0,025 to 3,5 (System A 1) 0,500 to 14 (System A2)**	23	0	-25
2	**0,025 to 3,5 (System A 1) 0,500 to 14 (System A2)**	23	0	-25
4	**0,025 to 3,5 (System A.1) 0,500 to 14 (System A.2)**	30	0	-25

NOTE: The 1 dB degradation of 10^{-6} BER threshold is considered equivalent to the BER degradation from 10^{-6} to 10^{-5}.

Annex B (normative): Frequency bands from 3 GHz to 11 GHz (channel separation up to 30 MHz and 56/60 MHz)

B.1 Introduction

The following point-to-point Digital Fixed Radio Systems are covered in this annex:

- B.1 Low and medium capacity and STM-0 digital radio system.
- B.2 High capacity digital radio systems carrying 1 × STM-1 signals and operating in frequency bands with about 30 MHz channel spacing and alternated arrangements (ACAP).
- B.3 High capacity digital radio systems carrying SDH signals (up to 2 × STM-1) in frequency bands with about 30 MHz channel spacing and using Co-polar arrangements (ACCP) or Co-Channel Dual Polarized (CCDP) operation.
- B.4 High capacity digital radio systems carrying 4 × STM-0 or 5 × 34 Mbit/s signals in frequency bands with about 30 MHz channel separation and using ACAP operation.
- B.5 High capacity digital radio systems carrying 8 × STM-0 or 10 × 34 signals in frequency bands with about 60 MHz channel separation and using ACAP operation.
- B.6 High capacity digital radio systems carrying 2 × STM-1 SDH signals (ACCP) or STM-4/4× STM-1 (CCDP) in frequency bands with about 60 MHz channel separation.

B.2 General characteristics

B.2.1 Frequency characteristics and channel arrangements

In table B.1, ITU-R and ECC (formerly CEPT/ERC) recommended frequency channel arrangements, known at the date of publication of the present document, are specified for reference only. The channel arrangement is not relevant to article 3.2 requirements; only the frequency band and actual channel separation are relevant for defining the set of parameters and test suites relevant to each system mainly designed for that channel separation and that frequency band.

Other national or future ITU-R or CEPT/ECC recommendations set around the rough boundary of present ITU-R or CEPT/ECC recommendations are considered applicable to systems assessed against the present document, provided that they use the same channel separation.

For assessment of wide-band coverage systems see annex G.

Table B.1: Frequency characteristics

Band (GHz)	Frequency range (GHz)	Channel separation (MHz)	Applicable to systems	Recommendations for radio frequency channel arrangements	
				ECC (CEPT/ERC) (see note 2)	ITU-R Recommendation (see note 1)
3,5	3,410 to 3,600	1,75 to 14	B.1	14-03 [i.17]	-
4	3,600 to 3,800	1,75 to 14	B.1	12-08 annex B part 2 [i.11]	-
	3,600 to 4,200	30	B.1, B2, B3, B4	12-08 annex A part 2 [i.11]	F.635-6 [i.36]
	3,600 to 4,200	60 (see note 2)	B.5, B.6	-	-
	3,800 to 4,200	29	B.1, B2, B3, B4	12-08 annex B part 1 [i.11]	F.382-8 [i.28]
	3,800 to 4,200	58 (see note 2)	B.5, B.6	-	-
U4	4,400 to 5,000	28 and 56	All	-	F.1099-4 annex 3 [i.43]
		60	B.5, B.6	-	F.1099-4 annex 1 [i.43]
L6	5,925 to 6,425	29,65 and 59,3	All	14-01 [i.15]	F.383-8 [i.29]
U6	6,425 to 7,100	3.5, 7, 14 and 20	B.1	14-02 [i.15]	F.384-10 [i.30]
	6,425 to 7,100	30 and 60	All	14-02 [i.15]	F.384-10 [i.30]
7	7,125 to 7,425	7 to 28 and 56	All	-	F.385-9 [i.31]
	7,425 to 7,725		All	-	F.385-9 F.385-9 annex 1 [i.31]
	7,250 to 7,550		All	-	F.385-9 [i.31]
	7,550 to 7,850		All	-	F.385-9 [i.31]
	7,110 to 7,750	28 and 56	All	-	F.385-9 annex 3 [i.31]
	7,425 to 7,900	7 to 28 and 56	All	-	F.385-9 annex 4 [i.31]
	7,250 to 7,550	3,5 to 28 and 56	All	-	F.385-9 annex 5 [i.31]
	7,125 to 7,425	1,75 to 28 and 56	All	02-06 annex 1 and annex 3 [i.9]	-
	7,425 to 7,725	1,75 to 28 and 56	All	02-06 annex 1 and annex 3 [i.9]	-
8	8,200 to 8,500	11,662 or 2 × 11,662	B.1	-	F.386-8 annex 7 [i.32]
	7,725 to 8,275	29,65 and 59,3	All	-	F.386-8 annex 6 [i.32]
	7,725 to 8,275	30 and 60	All		F.386-8 annex 1 [i.32]
	8,025 to 8,500	7 to 28 and 56	All		F.386-8 annex 5 [i.32]
	8,275 to 8,500	7 to 28 and 56	All	-	F.386-8 annex 2 [i.32]
	7,900 to 8,400	7 to 28 and 56	All	-	F.386-8 annex 3 [i.32]
	7,900 to 8,500	1,75 to 28 and 56	All	02-06 annex 2 and annex 3 [i.5]	-
10,5	10,000 to 10,680	3,5 to 28	B.1, B.2, B.3, B.4	-	F.746-9 annex 2 [i.39]
	10,500 to 10,680	7	B.1	-	F.747 [i.40]
	10,150 to 10,3 paired with 10,5 to 10,650	3,5 to 28 and 56	All	12-05 [i.8]	-

NOTE 1: All ECC (CEPT/ERC), or ITU-R Recommendations listed in this clause are referred to in clause 2.2.
NOTE 2: In bands from 3,6 GHz to 4,2 GHz, systems B.5 and B.6 do not rely on any Recommended CEPT or ITU-R radio frequency channel arrangements providing channel separation up to 56 MHz to 60 MHz; however, in bands that provide 28 MHz to 30 MHz ChS, it is assumed that aggregation of two half sized channels might be permitted on national basis.

B.2.2 Transmission capacities

Table B.2: Nominal transmission capacity and system classes for various channel separation for particular PDH and STM bit rates

System →		B.1								B.2	B.3
Channel arrangement →		Co-polar (ACCP)								Cross-polar (ACAP)	Co-polar (ACCP/CCDP)
Nominal payload bit rate Mbit/s →		2	2 × 2	8	2 × 8	34	STM-0	2 × 34	2 × STM-0	STM-1	STM-1 (ACCP) 2 × STM-1 (CCDP)
Channel separation	Class 2	1,75 MHz	3,5 MHz	7 MHz 11,662 MHz	14 MHz 14,5 MHz 15 MHz	28 MHz 29 MHz 29,65 MHz 30 MHz	-	-	-	-	-
	Class 3	-	-	-	-	-	28 MHz 29 MHz 29,65 MHz 30 MHz	-	-	-	-
	Class 4L	-	1,75 MHz	3,5 MHz	7 MHz	14 MHz 14,5 MHz 15 MHz	20 MHz 21 MHz 2×11,662 MHz	28 MHz 29 MHz 29,65 MHz 30 MHz		-	-
	Class 4H						14 MHz 14,5 MHz 15 MHz		28 MHz 29 MHz 29,65 MHz 30 MHz	-	-
	Class 5A	-	-	-	-	-	-	-	-	28 MHz 29 MHz 29,65 MHz 30 MHz (see note 1)	-
	Class 5B	-	-	-	-	7 MHz	-	14 MHz 14,5 MHz 15 MHz	-	-	28 MHz 29 MHz 29,65 MHz 30 MHz

continued

Table B.2 (continued): Nominal transmission capacity and system classes for various channel separation for particular PDH and STM bit rates

System →		**B.4**	**B.5**	**B.6**
Channel arrangement →		**Cross polar (ACAP)**	**Cross polar (ACAP)**	**Co-polar (ACCP/CCDP)**
Nominal payload bit rate Mbit/s →		**4 x STM-0 5 x 34**	**8 x STM-0 10 x 34**	**2 × STM-1 (ACCP) STM-4/4 × STM-1 (CCDP)**
Channel separation	**Class 5B**	-	-	56 MHz to 60 MHz
	Class 6A	28 MHz 29 MHz 29,65 MHz 30 MHz	56 MHz to 60 MHz	-

NOTE 1: System B.2 includes two different sets of parameters, both intended for ACAP operation (class 5A) but with a different adjacent C/I requirement. They are identified here as types 1 and 2: Type 1 with a less stringent adjacent channel interference requirement or for trunk multi-channel applications and Type 2 with more stringent adjacent channel interference requirement.

NOTE 2: The capacities in table B.2 are commonly tailored to typical PDH and SDH data interfaces. For equipment assessment when other base band interfaces or a combination of them are required see annex F.

B.3 Transmitter

B.3.1 General requirements

Table B.3: Transmitter requirements

Requirements	System	
	B.1	**B.2, B.3, B.4, B.5, B.6**
Maximum transmitter power	Clause 4.2.1	
Nominal transmitter power tolerance	±B dB = ±2 dB	
Transmitter power and frequency control	Clause 4.2.2	
RF Spectrum mask	RF spectrum density mask in clause B.3.2	
Discrete CW components exceeding the spectrum mask limit: spectral lines at the symbol rate and other spectral lines	Clause 4.2.5	
Spurious emissions-external	Clause 4.2.6	
Radio frequency tolerance	±XX = ±15 ppm for equipment operating with channel separation lower than 14 MHz; and, ±XX = ±30 ppm for equipment operating with channel separation greater than or equal to 14 MHz	±XX = ±50 ppm or ±YY = ±400 kHz, whichever is the more stringent

B.3.2 RF spectrum masks

Spectrum masks are not inclusive of an allowance for radio frequency tolerance. Centre frequency f0 identifies the actual carrier frequency; the masks shall be extended up to 2,5 times the relevant CS of each system.

Table B.4, with reference to the relevant generic mask shape specified in clause 4.2.4.1, shows the offset frequency from f0 and attenuation of other corner points of the spectrum mask.

NOTE: In some cases the table provide two options labelled as "unified" and "alternative"; the latter being the one carried over from "historic" ENs now superseded, while the first derives from a more recent action of overall rationalization and unification among the various bands, channel separation and spectral efficiency classes.

Table B.4: Limits of power spectral density

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)	K6 (dB)	f6 (MHz)
B.1	2	2	1,75	Figure 4	+1	0,7	-23	1,4	-23	1,75	-45	3,5				
		2 × 2	3,5			1,4		2,8		3,5		7,0				
		8	7/11,662			2,7		5,6		6,5		13				
		2 × 8	14/14,5/15			5,4		11,2		13		26				
		34	28/29/29,65/30 (unified)			12,8		16,4		25		45,0				
			28/29/29,65/30 (alternative)			11,0		19								
	3	STM-0	28 /29 29,65/30	Figure 5	+1	7,5	-10	10,5	-30	12,5	-35	22	-55 (note 1)	30 (note 1)		
	4L	2 × 2	1,75	Figure 4	+1	0,7	-32	1,4	-37	1,75	-55 (note 1)	3,5(note 1)				
		8	3,5			1,4		2,8		3,5		7 (note 1)				
		2 × 8	7/11,662			2,8		5,6		7		14 (note 1)				
		34	14/14,5/15			5,6		11,2		14		28 (note 1)				
		2 × 34	28/29/29,65/30 (alternative)			11,2		22,4		28		56 (note 1)				
			28/29/29,65/30 (unified)			12,8	-27	17	-35							
	4H	STM-0	20/21 2 × 11,662	Figure 5	+1	7,5	-10	9,5	-33	12,5	-40	15	-55 (note1)	30 (note 1)		
		STM-0	14/14,5/15			6		7,5		8,4	-40	17,5		27,5 (note 1)		
		2 × STM-0	28/29 29,65/30			12		15		16,8	-40	35		55 (note 1)		
	5B	34	7	Figure 4	+1	3	-10	3,5	-30	4	-55 (note 1)	12,35 (note 1)				
		2 × 34	14/14,5/15			6		7		8		24,7 (note 1)				
B.2	5A (type 1)	STM-1	28/29 29,65/30 (ACAP)	Figure 4	+1	13	-35	20	-45	40	-55 (note 1)	50 (note 1)				
	5A (type 2)			Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-55 (note 1)	54 (note 1)
B.3	5B	STM-1 (ACCP) 2 × STM-1 (CCDP)	28/29 29,65/30	Figure 6	+2	12	-10	14,5	-32	15,5	-36	17	-45	40	-55 (note 1)	54 (note 1)
B.4	6A	4 x STM-0/ 5 x 34 (ACAP)	28/29 29,65/30	Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-55 (note 1)	54 (note 1)

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)	K6 (dB)	f6 (MHz)
B.5	**6A**	8 x STM-0/ 10 x 34 (ACAP)	56 to 60	Figure 6	+2	25	-10	30	-32	34	-35	40	-45	80	-55 (note 1)	108 (note 1)
B.6	**5B**	2 × STM-1 (ACCP) STM-4/ 4 × STM-1 (CCDP)	56 to 60	Figure 6	+2	24	-10	29	-32	31	-36	34	-45	80	-55 (note 1)	108 (note 1)

NOTE 1: For frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; the corresponding frequency corner on the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting corner points 4 or 5 or 6 only, are reported in the table below. Rationale for that is that cases of very congested nodal areas are not infrequent. Regulatory bodies, for the links converging in those nodal points, on a case by case basis, might limit the licensing only to equipment that fulfils the more stringent figure of -60 dB. Administrations, requiring for those special cases also the more tightening option, will mention it in the Interface Notification under article 4.1 of R&TTE Directive [1].
For fulfilling one or both requirements, equipment suppliers may choose to produce and assess different products.

System	Spectrum efficiency class	Nominal Bit rate (Mbit/s)	Channel separation (MHz)	K1/f1 to K3/f3 (dB/MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)	K6 (dB)	f6 (MHz)
B.1	**3**	STM-0	28/29/29,65/30	n.c.	n.c.	n.c.	-60	32		
	4L	2 × 2	1,75		-60	4				
		8	3,5			8				
		2 × 8	7/11,662			16				
		34	14/14,5/15			31,9				
		2 × 34	28/29/29,65/30			63,8				
	4H	STM-0	20/21/2 ×11,662		n.c.	n.c.	-60	35		
		STM-0	14/14,5/15					30,85		
		2 × STM-0	28/29/29,65/30					61,7		
	5B	34	7		-60	14				
		2 × 34	14/14,5/15			28				
B.2	**5A (type 1)**	STM-1	28/29/29,65/30 (ACAP)		-60	55				
	5A (type 2)				n.c.	n.c.	n.c.	n.c.	-60	61
B.3	**5B**	STM-1 (ACCP) 2 × STM-1 (CCDP)	28/29/29,65/30		n.c.	n.c.	n.c.	n.c.	-60	61
B.4	**6A**	4 x STM-0 / 5 x 34 (ACAP)	28/29/29,65/30		n.c.	n.c.	n.c.	n.c.	-60	61
B.5	**6A**	8 x STM-0 / 10 x 34 (ACAP)	56 to 60		n.c.	n.c.	n.c.	n.c.	-60	122
B.6	**5B**	2 × STM-1 (ACCP) STM-4 / 4 × STM-1 (CCDP)	56 to 60		n.c.	n.c.	n.c.	n.c.	-60	122

n.c.: No change with respect to table B.4.

B.4 Receiver

B.4.1 General requirements

Table B.5: Receiver requirements

Requirements	System
	All
Spurious emission (External)	Clause 4.3.1
BER as a function of RSL	Table B.6
Co-channel external and adjacent channel interference sensitivity	Table B.7
CW spurious response	Clause 4.3.4

B.4.2 BER as a function of Receiver input Signal Level (RSL)

The supplier shall declare the RSL threshold(s) (dBm) for the relevant BER values (i.e. 10^{-6} and 10^{-8} or 10^{-10}), which shall not be worse than the corresponding RSL upper bound values indicated in the table B.6. The declared Receiver Signal Levels (RSL) shall produce a BER $\leq 10^{-6}$ and either $\leq 10^{-8}$ or $\leq 10^{-10}$.

NOTE: RSL values, evaluated for typical implementation practice, may be found in TR 101 854 [i.26].

Table B.6: BER as a function of receiver input signal level RSL (upper bound)

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Co-polar channel separation (MHz)	RSL for BER ≤ 10^{-6} (dBm) (note 2)	RSL for BER ≤ 10^{-8} (dBm) (note 2)	RSL for BER ≤ 10^{-10} (dBm)
B.1 (note 2)	Class 2 (note 3)	2	1,75	-87	-	-
		2 × 2	3,5	-84		
		8	7/11,662	-82		
		2 × 8	14/14,5/15	-79		
		34	28/29/29,65/30	-76		
	Class 3	STM-0	28 to 30	-75	-73	-
	Class 4L	2 × 2	1,75	-84	-82	-
		8	3,5	-81	-79	
		2 × 8	7/11,662	-78	-76	
		34	14/14,5/15	-75	-73	
		2 × 34	28/29/29,65/30	-72	-70	
		STM-0	20 to 2 × 11,662	-75	-73	
	Class 4H	STM-0	14/14,5/15	-73	-71	
		2 × STM-0	28/29/29,65/30	-70	-68	
	Class 5B	34	7	-72,5	-70,5	-
		2 × 34	14/14,5/15	-69,5	-67,5	
B.2	Class 5A	STM-1 (Types 1 and 2) (note 1)	28/29/29,65/30 (ACAP)	-67	-	-63
B.3	Class 5B	STM-1 (ACCP) 2 × STM-1 (CCDP) (note 1)	28/29/29,65/30	-67	-	-63
B.4	Class 6A	4 x STM-0 / 5 x 34 (ACAP)	28/29/29,65/30	-61	-	-57
B.5	Class 6A	8 x STM-0 / 10 x 34 (ACAP)	56 to 60	-58	-	-54
B.6	Class 5B	2 × STM-1 (ACCP) STM-4 / 4 × STM-1 (CCDP)	56 to 60	-64	-	-60

NOTE 1: For class 5B STM-1/2 × STM-1 equipment, limits are required when the connection to the same antenna port of even and odd channels, spaced about 30 MHz apart on the same polarization, is designed for the use of a 3 dB hybrid coupler placed at reference point C. When alternatively, for the above purpose, narrow-band branching filters solution are used, the above BER performance thresholds may be relaxed by 1,5 dB.
For class 5A STM-1 and 5B STM-1/2 × STM-1 equipment, outdoors and partially outdoors systems that are not subject to the compatibility requirements (as stated in clause 4.2 of EN 302 217-2-1 [i.24]) there is a 2 dB relaxation on the above BER performance thresholds.
The above relaxed values are not intended to be additive: in cases where both could be applicable, the supplier shall declare which is adopted.

NOTE 2: For system B.1 equipment in bands from 8 GHz to 11 GHz allowance is given for relaxation of the figures by 1 dB.

NOTE 3: For class 2 systems, only RSL for BER ≤ 10^{-6} is standardized; however, in a previously published EN these systems were also required to meet a specific RSL for BER ≤ 10^{-3}, which were set 3 dB lower than the RSL for BER ≤ 10^{-6}. This value, given here for information only, may be used for deriving a typical RSL versus BER curve.

B.4.3 Co-channel "external" and adjacent channel interference sensitivity

The limits of Carrier to Interference ratio (C/I) in case of co-channel first adjacent interference shall be as set out in table B.7, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits declared for BER $\leq 10^{-6}$ in clause B.4.2.

NOTE: For the purpose of frequency co-ordination, intermediate co-channel or adjacent channel sensitivity values may be found in annex J.

Table B.7: Co-channel and adjacent channel interference sensitivity

				C/I for BER ≤ 10^{-6} RSL degradation of 1dB or 3dB			
				Co-channel interference		First adjacent channel interference	
System	**Spectrum efficiency class**	**Bit rate (Mbit/s)**	**Channel separation (MHz)**	**1 dB**	**3 dB**	**1 dB**	**3 dB**
B.1	**2**	2	1,75	23	19	0	-4
		2 × 2	3,5	23	19	0	-4
		8	7	23	19	0	-4
		8	11,662	23	19	-10	-14
		2 × 8	14/14,5/15	23	19	0	-4
		34	28/29/ 29,65/30	23	19	0	-4
	3	STM-0	28/29/ 29,65/30	30	26,5	-8	-12
	4L	2 × 2	1,75	30	26,5	-3	-7
		8	3,5	30	26,5	-3	-7
		2 × 8	7	30	26,5	-3	-7
		2 × 8	11,662	30	26,5	-10	-14
		34	14/14,5/15	30	26,5	-3	-7
		2 × 34	28/29/ 29,65/30	30	26,5	-3	-7
		STM-0	20/ 2 × 11,662	30	26,5	-8	-12
	4H	STM-0	14/14,5/15	33	29	-5	-9
		2 × STM-0	28/29/ 29,65/30	33	29	-5	-9
	5 B	34	7	33	29	-2	-6
		2 × 34	14/14,5/15				
B.2	**5 A**	1 × STM-1 (Type 1)	28	34	31	12,5	9,5
		1 × STM-1 (Type 1)	29-30	34	31	8,5	5,5
		1 × STM-1 (Type 2)	28/29/ 29,65/30	37	33	3	-1
B.3	**5 B**	STM-1/ 2 × STM-1	28/29/ 29,65/30	35	32	-5	-8
B.4	**Class 6A**	4 x STM-0/ 5 x 34	28/29/ 29,65/30	41	38	10	7
B.5	**Class 6A**	8 x STM-0/ 10 x 34	50 to 60	41	38	10	7
B.6	**Class 5B**	2 × STM-1 STM-4/ 4 × STM-1	56 to 60	35	32	-5	-8

Annex C (normative): Frequency bands from 3 GHz to 11 GHz (channel separation 40 MHz)

C.1 Introduction

The following point-to-point Digital Fixed Radio Systems are covered in this annex:

- C.1 High capacity fixed radio systems carrying SDH signals (up to 2 × STM-1) in frequency bands with 40 MHz channel separation and using Adjacent Channel Co-Polar arrangements (ACCP) or Co-Channel Dual Polarized (CCDP) operation.
- C.2 High capacity digital radio systems carrying STM-4 in two 40 MHz channels or 2 × STM-1 in a 40 MHz channel with alternate (ACAP) channel arrangements.
- C.3 High capacity digital radio systems transmitting STM-4 or 4 × STM-1 in a 40 MHz radio frequency channel using Co-Channel Dual Polarized (CCDP) operation.

C.2 General characteristics

C.2.1 Frequency characteristics and channel arrangements

In table C.1, ITU-R and ECC (formerly CEPT/ERC) recommended frequency channel arrangements, known at the date of publication of the present document, are specified for reference only. The channel arrangement is not relevant to article 3.2 requirements; only the frequency band and actual channel separation is relevant for defining the set of parameters and test suites relevant to each system designed for that channel separation.

Other national or future ITU-R or CEPT/ECC recommendations set around the rough boundary of present ITU-R or CEPT/ECC Recommendations are considered applicable to systems assessed against the present document, provided that they use the same channel separation.

For assessment of wide-band coverage systems see annex G.

Table C.1: Frequency characteristics

Band (GHz)	Frequency range (GHz)	Applicable to systems	Recommendations for radio frequency channel arrangements	
			CEPT/ECC (see note)	ITU-R (see note)
4	3,600 to 4,200	C.1, C.2, C.3	12-08 annex A part 1 [i.11]	F.635-6 [i.36]
U4	4,400 to 5,000	C.1, C.2, C.3	-	F.1099-4 annex 1 and annex 2 [i.43]
U6	6,425 to 7,110	C.1, C.2, C.3	14-02 [i.16]	F.384-10 [i.30]
8	7,725 to 8,275	C.1, C.2, C.3	-	F.386-8 annex 4
11	10,7 to 11,7	C.1, C.2, C.3	12-06 [i.9]	F.387-10
NOTE: All ECC (CEPT/ERC), or ITU-R Recommendations listed in this clause are referred to in clause 2.2.				

C.2.2 Transmission capacities

Table C.2: Nominal transmission capacity and system classes for various channel separation

System →		C.1	C.2		C.3
Channel arrangement →		Co-polar (ACCP/CCDP)	Cross-polar (ACAP)		Co-polar (ACCP/CCDP)
Nominal payload bit rate Mbit/s →		STM-1 ACCP Or 2 × STM-1 CCDP	2 × STM-1 ACAP	4 × STM-1/STM-4 ACAP	2 × STM-1 ACCP or 4 × STM-1/STM-4 CCDP
Channel separation	Class 5B	40 MHz co-polar (see note)	-	-	-
	Class 6A	-	40 MHz cross-polar	2 × 40 MHz cross-polar	-
	Class 6B	-	-	-	40 MHz co-polar

NOTE: System C.1 includes two different sets of parameters, both intended for ACCP or CCDP operation (class 5B) but with differences in some requirements. They are identified as types 1 and 2:
Type 1 is based on 30 MHz-like system technology (i.e. based on 128 states modulation).
Type 2 is based on 40 MHz-like system technology (i.e. based on 64 states modulation).

The capacities in table C.2 are commonly tailored to typical PDH and SDH data interface. For equipment assessment when other base band interfaces or a combination of them are required see annex F.

C.3 Transmitter

C.3.1 General requirements

Table C.3: Transmitter requirements

Requirements	System C.1	System C.2	System C.3
Maximum transmitter power	Clause 4.2.1		
Nominal transmitter power tolerance	B = ±2 dB	B = ±1 dB	B = ±1 dB
Transmitter power and frequency control	Clause 4.2.2		
RF Spectrum mask	RF spectral density mask in clause C.3.2		
Discrete CW components exceeding the spectrum mask limit: spectral lines at the symbol rate and other spectral lines	Clause 4.2.5		
Spurious emissions-external	Clause 4.2.6		
Radio frequency tolerance	±XX = ±50 ppm or ±YY = ±400 kHz, whichever is the more stringent	±XX = ±30 ppm	±XX = ±20 ppm

C.3.2 RF spectrum masks

Spectrum masks are not inclusive of allowance for radio frequency tolerance. Centre frequency f0 identifies the actual carrier frequency; the masks shall be extended up to 2,5 times the relevant CS of each system.

Table C.4, with reference to the relevant generic mask shape specified in clause 4.2.4.1, shows the offset frequency from f0 and attenuation of other discreet points of the spectrum mask.

Due to different implementations, system C.3 may use, on each polarization, single-carrier or multi-carried modulation formats; this results in two different spectrum masks that, however, are considered equivalent and do not impact upon any other requirement or the frequency planning procedure. Therefore the supplier may assess equipment selecting the mask that best fits the implementation.

Table C.4: Limits of power spectral density

System	Spectrum efficiency class	Channel separation (MHz)	Mask reference shape	K1 (dB)	F1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)
C.1	**5B**	40 ACCP/ CCDP	Figure 5	+1	17	-10	19,5	-35	24	-40	54	-55 (note)	67 (note)
C.2	**6A**	40 ACAP	Figure 5	+1	19,5	-32	25	-32	27	-50	35	-55 (note)	38,4 (note)
C.3	**6B (single carrier)**	40 ACCP/ CCDP	Figure 3	+1	19	-40	22	-55 (note)	29,8 (note)				
	6B (multi-carrier)	40 ACCP/ CCDP	Figure 5	+1	19,75	-20	20	-50	22,5	-50	28	-55 (note)	31 (note)

NOTE: For frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at-60 dB is also here below provided; the corresponding frequency corner is derived by linear interpolation from the values in table C.4. For clarity these values, affecting corner points 3 or 5 only, are reported in the table below. Rationale for that is that cases of very congested nodal area are not infrequent. Regulatory bodies, for the links converging in those nodal points, on a case by case basis, might limit the licensing only to equipment that fulfils the more stringent figure of -60 dB. Administrations, requiring for those special cases also the more tightening option, will mention it in the Interface Notification under article 4.1 of R&TTE Directive [1].
For fulfilling one or both requirements, equipment supplier may choose to produce and assess different products.

System	Spectrum efficiency class	Channel separation (MHz)	K1/f1, K2/f2 (dB/MHz)	K3 (dB)	f3 (MHz)	K4/f4 (dB/MHz)	K5 (dB)	f5 (MHz)
C.1	**5B**	40 (ACCP / CCDP)	n.c.	n.c.	n.c.	n.c.	-60	71,3
C.2	**6A**	40 (ACAP)		n.c.	n.c.	n.c.	-60	41,8
C.3	**6B (single carrier)**	40 (ACCP / CCDP)		-60	32,4			
	6B (multi-carrier)	40 (ACCP / CCDP)		n.c.	n.c.	n.c.	-60	34

n.c. : no change with respect to table C.4

C.4 Receiver

C.4.1 General requirements

Table C.5: Receiver requirements

Requirements	System		
	C.1	**C.2**	**C.3**
Spurious emissions (external)	Clause 4.3.1		
BER as a function of RSL	Table C.6		
Co channel external and adjacent interference sensitivity	Table C.7		
CW spurious interference	Clause 4.3.4		

C.4.2 BER as a function of Receiver input Signal Level (RSL)

The supplier shall declare the RSL threshold(s) (dBm) for the relevant BER values (i.e. 10^{-6} and 10^{-10}), which shall not be worse than the corresponding RSL upper bound values indicated in the table C.6. The declared Receiver Signal levels shall produce a BER of either $\leq 10^{-6}$ or $\leq 10^{-10}$.

NOTE: RSL values, evaluated for typical implementation practice, may be found in TR 101 854 [i.26].

Table C.6: BER as a function of receiver input signal level RSL (upper bound)

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Frequency band(s)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-10} (dBm)
C.1	**5 B (Type 1)**	STM-1 (ACCP) 2 × STM-1 (CCDP)	40 ACCP/CCDP	4 GHz, 5 GHz, U6 GHz, 8 GHz	-65	-62
				11 GHz	-64	-61
	5 B (Type 2)	STM-1 (ACCP) 2 × STM-1 (CCDP) (see note)	40 ACCP/CCDP	4 GHz, 5 GHz, U6 GHz, 8 GHz	-69	-65
				11 GHz	-67,5	-63,5
C.2	**6 A**	STM-4 /4 × STM-1 or 2 × STM-1	2 × 40 ACAP 40 ACAP	4 GHz, 5 GHz	-60	-54
				U6 GHz, 8 GHz	-59,5	-53,5
				11 GHz	-58,5	-52,5
C.3	**6 B**	2 × STM-1 (ACCP) STM-4 / 4 × STM-1 (CCDP) (see note)	40 ACCP/CCDP	4 GHz, 5 GHz, U6 GHz, 8 GHz	-59	-54
				11 GHz	-58	-53

NOTE: These limits are required when the connection to the same antenna port of even and odd channels, spaced about 40 MHz apart on the same polarization, is made with a 3 dB hybrid coupler placed at reference point C. When alternatively, for the above purpose, narrow-band branching filters solutions are used, the above BER performance thresholds may be relaxed by 1,5 dB.
For outdoors and partially outdoors systems that are not subject to the compatibility requirements (as stated in clause 6.5 of EN 302 217-2-1 [i.24]) there is a 2 dB relaxation on the above BER performance thresholds.
The above relaxed values are not intended to be additive, in cases where both could be applicable, the supplier shall declare which is adopted.

C.4.3 Co-channel "external" and adjacent channel interference sensitivity

The limits of Carrier to Interference ratio (C/I) in case of co-channel and adjacent channel interference shall be as in table C.7, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits declared for BER $\leq 10^{-6}$ in clause C.4.2.

Table C.7: Co-channel and adjacent channel interference sensitivity

				C/I for BER ≤ 10^{-6} RSL degradation of 1 dB or 3 dB			
				Co-channel interference		**First adjacent channel interference**	
System	**Spectrum efficiency class**	**Bit rate (Mbit/s)**	**Channel separation (MHz)**	**1 dB**	**3 dB**	**1 dB**	**3 dB**
C.1	**5 B (Type 1)**	STM-1 (ACCP) 2 × STM-1(CCDP)	40	37	33	-4	-8
	5 B (Type 2)	STM-1 (ACCP) 2 × STM-1 (CCDP)	40	33	29	-4	-8
C.2	**6 A**	2 × STM-1 or STM-4 /4 × STM-1	40 ACAP 2 × 40 ACAP	43	39,5	15	11,5
C.3	**6 B**	2 × STM-1 (ACCP) STM-4 / 4 × STM-1 (CCDP)	40 ACCP/CCDP	44	40	-4	-8

Annex D (normative): Frequency bands 13 GHz, 15 GHz and 18 GHz

D.1 Introduction

The following point-to-point Digital Fixed Radio Systems are covered in this annex (see note):

- D.1 Low and medium capacity Plesiochronous Digital Hierarchy (PDH) radio systems operating in the 13 GHz, 15 GHz and 18 GHz frequency bands.
- D.2 Radio systems for the transmission of Sub-STM-0 digital signals operating in the 18 GHz frequency band.
- D.3 STM-0 digital radio systems operating in the 13 GHz, 15 GHz and 18 GHz frequency bands with about 28 MHz co-polar (ACCP) and 14 MHz cross-polar (ACAP) channel separation.
- D.4 STM-0 or 2 x STM-0 digital radio systems operating in the 13 GHz, 15 GHz and 18 GHz frequency bands with about 14 MHz or about 28 MHz co-polar (ACCP) channel separation.
- D.5 High capacity digital radio systems carrying 1 × STM-1 signals and operating in frequency bands with about 30 MHz channel separation and alternated arrangements (ACAP) operating in the 13 GHz, 15 GHz and 18 GHz frequency bands.
- D.6 High capacity digital radio systems carrying SDH signals (up to 2 × STM-1) in frequency bands with about 30 MHz channel separation and using Adjacent Channel Co-polar (ACCP) arrangements or Co-Channel Dual Polarized (CCDP) operation operating in the 13 GHz, 15 GHz and 18 GHz frequency bands.
- D.7 Radio systems for the transmission of STM-1 digital signals operating in the 15 GHz and 18 GHz frequency bands with channel separation of 55 MHz or 56 MHz.
- D.8 High capacity digital radio systems carrying STM-4, 4 × STM-1 or 2 × STM-1 signals in bands with 55 MHz or 56 MHz channel separation operating in the 13 GHz, 15 GHz and 18 GHz frequency bands.
- D.9 High capacity digital radio systems carrying 4 × STM-0/5 × 34 Mbit/s signals in bands with 27,5 MHz/28 MHz channel separation and alternated arrangements (ACAP) operating in the 13 GHz, 15 GHz and 18 GHz bands.
- D.10 High capacity digital radio systems carrying 8 × STM-0/10 × 34 Mbit/sec signals in bands with 55/56 MHz channel separation and alternated arrangements (ACAP) operating in the 13 GHz, 15 GHz and 18 GHz bands.

NOTE: Since recommended channel separation lower than 13,75 MHz are not available in the 18 GHz frequency band at the date of the present document, the equipment requirements set for systems D.1, D.2 and D.4 for CS 1,75 MHz to 14 MHz are considered for the use in national frequency plans based on 1,75 MHz, 3,5 MHz, 7 MHz and 14 MHz basic pattern, as recognized in CEPT/ERC Recommendation 12-03 [7].

D.2 General characteristics

D.2.1 Frequency characteristics and channel arrangements

In table D.1, ITU-R and ECC (formerly CEPT/ERC) recommended frequency channel arrangements, known at the date of publication of the present document, are specified for reference only. The channel arrangement is not relevant to article 3.2 requirements; only the frequency band and actual channel separation are relevant for defining the set of parameters and test suites relevant to each system designed for that channel separation.

Other national or future ITU-R or CEPT/ECC recommendations set around the rough boundary of present ITU-R or CEPT/ECC recommendations are considered applicable to systems assessed against the present document, provided that they use the same channel separation.

For assessment of wide-band coverage systems see annex G.

Table D.1: Frequency characteristics

Band (GHz)	Frequency range (GHz)	Channel separation (MHz)	Applicable to	Recommendations for radio frequency channel arrangements	
				ECC (CEPT/ERC) (note 3)	ITU-R (note 3)
13	12,75 to 13,25	1,75 to 28	D.1, D.3, D.4, D.5, D.6 and D.9	12-02E [i.6]	F.497-7 [i.34]
13	12,75 to 13,25	56	D.8 and D.10	12-02E [i.6]	F.497-7 [i.34]
15	14,5 to14,62 paired with 15,23 to15,35 or 14,5 to 15,35	1,75 to 56	All excluding D.2	T/R 12-07 [i.10]	F.636-3 [i.37]
18	17,7 to 19,700	13,75 to 55 or 1,75 to 14 (note 2)	All	12-03 [i.7] (note 1)	F.595-9 [i.35] (note 1)

NOTE 1: CEPT Recommendation 12-03 [7] allows for low-capacity channel arrangements on a national basis. ITU-R Recommendation F.595-9 [i.35] details various channel arrangements including low-capacity channel arrangements.
NOTE 2: As recommended CEPT channel separation lower than 13,75 MHz are not available in the 18 GHz frequency band at the date of the present document, the equipment requirements set for system D.1 for CS 1,75 MHz to 14 MHz are considered for the use in national frequency plans based on 1,75/3,5/7/14 MHz basic pattern.
NOTE 3: All ECC (CEPT/ERC), or ITU-R Recommendations listed in this clause are referred to clause 2.2.

D.2.2 Transmission capacities

The capacities in tables D.2a and D.2b are commonly tailored on typical PDH and SDH data interface. For equipment assessment when other base band interfaces or a combination of them are required see annex F.

Table D.2a: Nominal transmission capacity and system classes for various channel separation (PDH, STM-0 and sub-STM-0 bit rates)

System		D.1						D.2		D.3	D.4		D.9	D.10
Channel arrangement		Co-polar (ACCP)						Co-Polar (ACCP)		Co-polar (ACCP) (note 2)	Co-Polar (ACCP)		Cross-polar (ACAP)	Cross-polar (ACAP)
Nominal payload bit rate (Mbit/s)		2	2 × 2	8	2 × 8	34	2 × 34	sSTM-14 (9,792)	SSTM-22 (14,400)	STM-0	STM-0	2 × STM-0	4 x STM-0/ 5 x 34	8 x STM-0/ 10 x 34
Channel separation	Class 2	1,75 MHz	3,5 MHz	7 MHz	14 MHz/ 13,75 MHz	28 MHz /27,5 MHz	56 MHz /55 MHz (note 1)	-	-	-	-	-	-	-
	Class 3	--	-	-	-	-	-	-	-	28 MHz/ 27,5 MHz (note 2)	-	-	-	-
	Class 4L	-	1,75 MHz	3,5 MHz	7 MHz	14 MHz/ 13,75 MHz	28 MHz /27,5 MHz	-	-	-			-	-
	Class 4H	-	-	-	-	-	-	3,5 MHz	-	-	14 MHz/ 13,75 MHz	28 MHz/ 27,5 MHz	-	-
	Class 5B	-	-	-	-	7 MHz	14 MHz/ 13,75 MHz	-	3,5 MHz	-	-	-	-	-
	Class 6A	-	-	-	-	-	-	-	-	-	-	-	28 MHz/ 27,5 MHz	56 MHz/ 55 MHz

NOTE 1: 15 GHz and 18 GHz bands only.
NOTE 2: Class 3, STM-0 equipment in 15 GHz band is also designed to operate cross-polarization using 14 MHz adjacent channels (ACAP systems). Provided that their adjacent channel interference sensitivity requirements are set for both 14 MHz and 28 MHz (see clause D.4.3), these systems may be deployed on 14 MHz or 28 MHz CS plans.

Table D.2b: Nominal transmission capacity and system classes for various channel separation (STM-N bit rates)

System		D.5	D.6	D.7	D.8	
Channel arrangement		Cross-polar (ACAP)	Co-polar (ACCP/CCDP)	Co-polar (ACCP/CCDP)	Co-polar (ACCP/CCDP)	Cross-polar (ACAP)
Nominal payload bit rate Mbit/s		STM-1 (note 2)	STM-1 (ACCP) 2 × STM-1 (CCDP)	STM-1 (ACCP) 2 × STM-1 (CCDP)	2 × STM-1 (ACCP) STM-4/4 × STM-1 (CCDP) (note 1)	2 × STM-1 (note 1)
Channel separation	Class 4L	-	-	55/56 MHz (note 3)	-	-
	Class 5A	27,5/28 MHz	-	-	-	55/56 MHz
	Class 5B	-	27,5/28 MHz	-	55/56 MHz	-

NOTE 1: Each carrier is considered a separate 2 × STM-1 system. STM-4/4 × STM-1 applications, besides the use of CCDP systems, may be implemented also with two 2 × STM-1 (ACCP or ACAP) on two separate 55/56 MHz channels that, due to spectrum availability and channel licensing, may be implemented using non adjacent channels.
NOTE 2: System D.5 includes two different set of parameters, both intended for ACAP operation (class 5A) but with sensible difference in adjacent C/I requirement. They are here formally identified as type 1 and 2: Type 1 with less stringent adjacent channel interference requirement or for trunk multi-channel applications and Type 2 with more stringent adjacent channel interference requirement.
NOTE 3: 15 GHz and 18 GHz bands only.

D.3 Transmitter

D.3.1 General requirements

Table D.3: Transmitter Requirements

Requirements	System				
	D.1 and D.2	**D.3**	**D.4**	**D.5 and D.6**	**D.7, D.8, D.9 and D.10**
Maximum transmitter power	Clause 4.2.1				
Nominal transmitter power tolerance	±B = ±2 dB				
Transmitter power and frequency control	Clause 4.2.2				
RF spectrum mask	RF spectral density mask in clause D.3.2				
Discrete CW components exceeding the spectrum mask spectral lines at the symbol rate and other spectral lines	Clause 4.2.5				
Spurious emissions-external	Clause 4.2.6				
Radio frequency tolerance	±XX = ±10 ppm	±XX = ±30 ppm	±XX = ±15 ppm	13/15 GHz bands: ±XX = ±50 ppm or ±YY = ±400 kHz, whichever is the more stringent. 18 GHz band: ±XX = ±15 ppm	±XX = ±15 ppm

D.3.2 RF spectrum masks

Spectrum masks are not inclusive of an allowance for radio frequency tolerance. Centre frequency f0 identifies the actual carrier frequency; the masks shall be extended up to 2,5 times the relevant CS of each system.

Table D.4, with reference to the relevant generic mask shape specified in clause 4.2.4.1, shows the offset frequency from f0 and attenuation of other discreet points on the spectrum mask.

NOTE: In some cases the table provide two options labelled as "unified" and "alternative"; the latter being the one carried over from "historic" ENs now superseded, while the first derives from a more recent action of overall rationalization and unification among the various bands, channel separation and spectral efficiency classes.

Table D.4a: Limits of Spectral Power Density (13 and 15 GHz only)

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)	K6 (dB)	f6 (MHz)
D.1	2	2	1,75	Figure 4	+1	0,7	-23	1,4	-23	1,75	-45	3,5				
		2 × 2	3,5			1,4		2,8		3,5		7				
		8	7			2,7		5,6		6,5		13				
		2 × 8	14			5,4		11,2		13		26				
		34	28 (alternative)			11		19		25		45				
			28 (unified)			12,8		16,4		25		45				
		2 × 34	56 (15 GHz only)			25,6		32,8		50		90				
	4L	2 × 2	1,75	Figure 4	+1	0,7	-32	1,4	-37	1,75	-55	3,5				
		8	3,5			1,4		2,8		3,5		7				
		2 × 8	7			2,8		5,6		7		14				
		34	14			5,6		11,2		14		28				
		2 × 34	28 (alternative)			11,2		22,4		28		56				
			28 (unified)			12,8	-27	17	-35	28		56				
	5B	34	7	Figure 6	+2	3	-10	3,625	-32	3,875	-36	4,25	-45	10	-55	13,5
		2 × 34	14			6		7,25		7,75		8,5		20	-55	27
D.3	3	STM-0	28	Figure 5	+1	7,5	-10	10,5	-30	12,5	-35	22	-50	30		
D.4	4H	STM-0	14	Figure 5	+1	6	-10	7,5	-33	8,4	-40	17,5	-50	24,15		
		2 × STM-0	28			12		15		16.8		35		48,3		
D.5	5A (type 1)	STM-1 (ACAP)	28	Figure 4	+1	13	-35	20	-45	40	-55	50				
	5A (type 2)			Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-55	54
D.6	5B	STM-1 (ACCP) 2 × STM-1 (CCDP)	28	Figure 6	+2	12	-10	14,5	-32	15,5	-36	17	-45	40	-55	54
D.7	4L	STM-1 (ACCP)	56 (15 GHz only)	Figure 4	+1	25,6	-27	34	-35	56	-55	112				
D.8	5A	2 × STM-1 (ACAP)	56	Figure 6	+2	25	-10	30	-32	34	-35	40	-45	80	-55	108
	5B	2 × STM-1 (ACCP) STM-4/ 4 × STM-1 (CCDP)		Figure 6	+2	24	-10	29	-32	31	-36	34	-45	80	-55	108
D.9	6A	4 x STM-0/ 5 x 34 (ACAP)	28	Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-55	54
D.10	6A	8 x STM-0/ 10 x 34 (ACAP)	56	Figure 6	+2	25	-10	30	-32	34	-35	40	-45	80	-55	108

Table D.4b: Limits of Spectral Power Density (18 GHz only)

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)	K6 (dB)	f6 (MHz)
D.1	2	2	1,75	Figure 4	+1	0,7	-23	1,4	-23	1,75	-45	3,5				
		2 × 2	3,5			1,4		2,8		3,5		7				
		8	7			2,7		5,6		6,5		13				
		2 × 8	14/13,75			5,4		11,2		13		26				
		34	27,5 (unified)			12,8		16,4		25		45				
			27,5 (alternative)			11		19								
		2 × 34	55			25,6		32.8		50		90				
	4L	2 × 2	1,75	Figure 4	+1	0,7	-32	1,4	-37	1,75	-50	3				
		8	3,5			1,4		2,8		3,5		6				
		2 × 8	7			2,8		5,6		7		12				
		34	14/13,75			5,6		11,2		14		24				
		2 × 34	27,5 (alternative)			11,2		22,4		28		48				
			27,5 (unified)			12,8	-27	17	-35	28	-50	49				
	5B	34	7	Figure 6	+2	3	-10	3,625	-32	3,875	-36	4,25	-45	10	-50	11,75
		2 × 34	14/13,75			6		7,25		7,75		8,5		20	-50	23,5
D.2	4H	sSTM-14 (9,792 Mbit/s)	3,5	Figure 4	+1	1,4	-30	2,8	-35	3,5	-50	5,45				
	5B	sSTM-22 (14,4 Mbit/s)	3,5			1,4		2,8		3,5	-50	5,45				
D.3	3	STM-0	27,5	Figure 5	+1	7,5	-10	10,5	-30	12,5	-35	22	-50	30		
D.4	4H	STM-0	14/13,75	Figure 5	+1	6	-10	7,5	-33	8,4	-40	17,5	-50	24,15		
		2 × STM-0	27,5			12		15		16.8		35		48,3		
D.5	5A (type 2)	STM-1(ACAP)	27,5	Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-50	47
D.6	5B	STM-1 (ACCP) 2 × STM-1 (CCDP)	27,5	Figure 6	+2	12	-10	14,5	-32	15,5	-36	17	-45	40	-50	47
D.7	4L	STM-1 (ACCP)	55 (unified)	Figure 4	+1	25,6	-27	34	-35	56	-50	98				
			55 (alternative)	Figure 4	+1	22,5	-30	33	-40	70	-50	80				
D.8	5A	2 × STM-1 (ACAP)	55	Figure 6	+2	25	-10	30	-32	34	-35	40	-45	80	-50	94
	5B	2 × STM-1(ACCP) STM-4 / 4 × STM-1 (CCDP)		Figure 6	+2	24	-10	29	-32	31	-36	34	-45	80	-50	94
D.9	6A	4 x STM-0 / 5 x 34 (ACAP)	27,5	Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-50	47
D.10	6A	8 x STM-0 / 10 x 34 (ACAP)	55	Figure 6	+2	25	-10	30	-32	34	-35	40	-45	80	-50	94

D.4 Receiver

D.4.1 General requirements

Table D.5: Receiver requirements

Requirements	System
	All
Spurious emissions (External)	Clause 4.3.1
BER as a function of RSL	Table D.6
Co channel external and adjacent interference sensitivity	Table D.7
CW spurious interference	Clause 4.3.4

D.4.2 BER as a function of Receiver input Signal Level (RSL)

The supplier shall declare the RSL threshold(s) (dBm) for the relevant BER values (i.e. 10^{-6} and 10^{-8} or 10^{-10}), which shall not be worse than the corresponding RSL upper bound values indicated in the table D.6. The declared Receiver Signal levels shall produce a BER of 10^{-6} or either $\leq 10^{-8}$ or $\leq 10^{-10}$.

NOTE: RSL values, evaluated for typical implementation practice, may be found in TR 101 854 [i.26]

Table D.6: BER as a function of receiver input signal level RSL (upper bound)

Spectrum efficiency class	System	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Frequency band(s) (GHz)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-10} (dBm)
2 (note 4)	**D.1**	2	1,75	13, 15	-86	-	-
		2 × 2	3,5		-83	-	-
		8	7		-81	-	-
		2×8	14		-78	-	-
		34	28		-75	-	-
		2 x 34	56	15	-72	-70	-
		2	1,75	18	-85	-	-
		2 × 2	3,5		-82	-	-
		8	7		-80	-	-
		2×8	14/13,75		-77	-	-
		34	27,5		-74	-	-
		2 x 34	55		-71	-69	-
3	**D.3**	STM-0	28 (ACCP)	13	-74	-72	-
			14 (ACAP) 28 (ACCP)	15	-73	-71	-
			27,5 (ACCP)	18			
4L	**D.1**	2 × 2	1,75	13, 15	-80	-78	-
		8	3,5		-78	-76	-
		2×8	7		-76	-74	-
		34	14		-73	-71	-
		2 × 34	28		-70	-68	-
		2 × 2	1,75	18	-79	-77	-
		8	3,5		-77	-75	-
		2×8	7		-75	-73	-
		34	14/13,75		-72	-70	-
		2 × 34	27,5		-69	-67	-
	D.7	STM-1	55		-69	-67	-
			56	15	-70	-68	-

Spectrum efficiency class	System	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Frequency band(s) (GHz)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-10} (dBm)
4H	D.4	STM-0	14	13	-72	-70	-
		2 × STM-0	28		-69	-67	-
		STM-0	14	15	-72	-70	-
		2 × STM-0	28		-69	-67	-
		STM-0	13,75	18	-71	-69	-
		2 × STM-0	27,5		-68	-66	-
	D.2	sSTM-14	3,5		-78	-76	-
5A	D.5	STM-1 (Types 1 and 2) (note 2)	28	13	-66	-	-62
				15	-65,5	-	-61,5
		STM-1	27,5	18	-64	-62	-
5B	D.2	SSTM-22	3,5	18	-73	-71	-
	D.1	34	7	13	-72	-70	-
			7	15	-71,5	-69,5	-
			7	18	-70	-68	-
		2 × 34	14	13	-69	-67	-
			14	15	-68,5	-66,5	-
			13,75	18	-67	-65	-
	D.6	STM-1(ACCP) 2 × STM-1 (CCDP) (notes 1, 2)	28	13	-66	-	-62
				15	-65,5	-	-61,5
		STM-1(ACCP) 2 × STM-1 (CCDP)	27,5	18	-64	-62	-
5A and 5B	D.8	2 × STM-1 (ACAP or ACCP) (note 3)	56	13	-61,5	-59,5	-
			56	15	-61	-59	-
			55	18	-60	-58	-
6A	D.9	4 x STM-0/ 5 x 34 (ACAP)	27,5/28	13	-60	-58	-
				15	-59.5	-57,5	-
				18	-58,5	-56,5	-
	D.10	8 x STM-0/ 10 x 34 (ACAP)	55/56	13	-57	-55	-
				15	-56,5	-54,5	-
				18	-55,5	-53,5	-

NOTE 1: For these class 5B STM-1/2 × STM-1 systems, limits are required when the connection to the same antenna port of even and odd channels, spaced about 30 MHz apart on the same polarization, is designed for the use of a 3 dB hybrid coupler placed at reference point C. When alternatively, for the above purpose, narrow-band branching filters solution are used, the above BER performance thresholds may be relaxed by 1,5 dB.

NOTE 2: For class 5A STM-1 and 5B STM-1/2 × STM-1 equipment, outdoors and partially outdoors systems that are not subject to the compatibility requirements (as stated in clause 6.5 of EN 302 217-2-1 [i.24]) there is a 2 dB relaxation on the above BER performance thresholds.
The above relaxed values and that provided by note 1 are not intended to be additive, in cases where both could be applicable, the supplier shall declare which is adopted.

NOTE 3: Equipment requirements are set only on the basis of 2 × STM-1 rate. 4 × STM-1 or STM-4 capacity is made by doubling up 2 × STM-1 equipment either in CCDP operation or through operation of two 2 × STM-1 systems in two 55/56 MHz channels.

NOTE 4: For most class 2 systems, only RSL for BER ≤ 10^{-6} is standardized; however, in a previously published EN these systems were also required to meet a specific RSL for BER ≤ 10^{-3}, which were set 3 dB lower than the RSL for BER ≤ 10^{-6}. This value, given here for information only, may be used for deriving a typical RSL versus BER curve.

D.4.3 Co-channel "external" and adjacent channel interference sensitivity

The limits of Carrier to Interference ratio (C/I) in case of co-channel and adjacent channel interference shall be as in table D.7, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits declared for BER $\leq 10^{-6}$ in clause D.4.2.

Table D.7: Co-channel and adjacent channel interference sensitivity

				C/I for BER ≤ 10^{-6} RSL degradation of 1 dB or 3 dB			
				Co-channel interference		adjacent channel interference	
Spectrum efficiency class	**System**	**Nominal bit rate (Mbit/s)**	**Channel separation (MHz)**	**1 dB**	**3 dB**	**1 dB**	**3 dB**
2	**D.1**	2	1,75	23	19	0	-4
		2 × 2	3,5	23	19	0	-4
		8	7	23	19	0	-4
		2 × 8	14	23	19	0	-4
		2 × 8	13,75	23	19	1	-3
		34	28	23	19	0	-4
		34	27,5	23	19	1	-3
		2 x 34	56	23	19	0	-4
		2 x 34	55	23	19	1	-3
3	**D.3**	STM-0	28/27,5 (ACCP)	30	26,5	-10	-13,5
			14 (ACAP)	30	26,5	18	14,5
4L	**D.1**	2 × 2	1,75	30	26,5	-1	-5
		8	3,5	30	26,5	-1	-5
		2 × 8	7	30	26,5	-1	-5
		34	14	30	26,5	-1	-5
		34	13,75	30	26,5	0	-4
		2 × 34	28	30	26,5	-1	-5
		2 × 34	27,5	30	26,5	0	-4
	D.7	STM-1	55/56	29	25	-5	-9
4H	**D.4**	STM-0	14	30	26,5	-6	-9,5
		STM-0	13,75	30	26,5	-2	-5,5
		2 × STM-0	28	30	26,5	-6	-9,5
		2 × STM-0	27,5	30	26,5	-2	-5,5
	D.2	sSTM-14	3,5	30	26	-4	-8
5A	**D.5**	1 × STM-1 (Type 1)	28	34	31	12,5	9,5
		1 × STM-1 (Type 2)	27,5/28	37	33	3	-1
	D.8	2 × STM-1 (see note)	55/56	37	33	3	-1
5B	**D.1**	34	7	37	33	-3,5	-7,5
		2 × 34	13,75/14	37	33	-3,5	-7,5
	D.2	SSTM-22	3,5	37	33	0	-4
	D.6	STM-1(ACCP)	28	35	32	-5	-8
		2 × STM-1(ACDP)	27,5	37	33	-3	-7
	D.8	2 × STM-1 (see note)	55/56	37	33	-3,5	-7,5
6A	**D.9**	4 x STM-0/ 5 x 34	27,5/28	41	38	10	7
	D.10	8 x STM-0/ 10 x 34	55/56	41	38	10	7
NOTE: Equipment requirements are set out on the basis of a 2 × STM-1 rate. 4 × STM-1 or STM-4 is possible by doubling up 2 × STM-1 equipment either in CCDP operation or through operation of two 2 × STM-1 systems in two 55/56 MHz channels.							

Annex E (normative): Frequency bands from 23 GHz to 55 GHz

E.1 Introduction

The following point-to-point Digital Fixed Radio Systems are covered in this annex:

- E.1 Radio systems for the transmission of digital signals operating in the 23 GHz frequency band.
- E.2 Radio system for the transmission of digital signals operating in the frequency range 24,5 GHz to 29,5 GHz.
- E.3 Radio systems for the transmission of digital signals operating in the 31 GHz, 32 GHz and 38 GHz frequency bands.
- E.4 High capacity digital radio relay systems carrying STM-4, 4 × STM-1 or 2 × STM-1 signals in bands with 55 MHz or 56 MHz channel separation operating in the frequency range 23 GHz to 38 GHz.
- E.5 Low and medium capacity digital radio systems operating in the 50 GHz frequency band.
- E.6 Radio systems for the transmission of digital signals operating in the 52 GHz frequency band.
- E.7 Radio systems for the transmission of digital signals operating in the 55 GHz frequency band.

E.2 General characteristics

E.2.1 Frequency characteristics and channel arrangements

In table E.1, ITU-R and ECC (formerly CEPT/ERC) recommended frequency channel arrangements, known at the date of publication of the present document, are specified for reference only. The channel arrangement is not relevant to article 3.2 requirements; only the frequency band and actual channel separation are relevant for defining the set of parameters and test suites relevant to each system designed for that channel separation.

Other national or future ITU-R or CEPT/ECC recommendations set around the rough boundary of present ITU-R or CEPT/ECC recommendations are considered applicable to systems assessed against the present document, provided that they use the same channel separation.

For assessment of wide-band coverage systems see annex G.

Table E.1: Frequency characteristics

Band (GHz)	Frequency range (GHz)	Channel separation (MHz)	Applicable to systems	Recommendations for radio frequency channel arrangements	
				ECC (CEPT/ERC) (see note 1)	ITU-R (see note 1)
23	22,0 to 23,6	3,5 to 56	E.1, E.4	T/R 13-02 [i.20]	F.637-3 [i.38]
26	24,5 to 26,5	3,5 to 56	E.2, E.4	T/R 13-02 [i.20]	F.748-4 [i.41]
28	27,5 to 29,5	3,5 to 56	E.2, E.4	T/R 13-02 [i.20]	F.748-4 [i.41]
31	31,0 to 31,3	3,5 to 28/56 (see note 2)	E.3, E.4	02-02 [i.4]	F.746-9 annex 7 [i.39]
32	31,8 to 33,4	3,5 to 56	E.3, E.4	01-02 [i.3]	F.1520-2 [i.47]
38	37,0 to 39,5	3,5 to 56	E.3, E.4	T/R 12-01 [i.18]	F.749-2 [i.42]
50	48,5 to 50,2	3,5 to 28	E.5	12-10 [i.12]	-
52	51,4 to 52,6	3,5 to 56	E.6	12-11 [i.13]	F.1496-1 [i.45]
55	55,78 to 57,0	3,5 to 56	E.7	12-12 [i.14]	F.1497-1 [i.46]

NOTE 1: All ECC (CEPT/ERC), or ITU-R Recommendations listed in this clause are referred to in clause 2.2.
NOTE 2: In 31 GHz band, systems E.3 does not rely on any Recommended CEPT or ITU-R radio frequency channel arrangements providing channel separation of 56 MHz; however, it is assumed that aggregation of two half sized channels might be permitted on national basis.

E.2.2 Transmission capacities

The capacities in table E.2 are commonly tailored on typical PDH and SDH data interfaces. For equipment assessment when other base band interfaces or a combination of them are required see annex F.

Table E.2: Nominal transmission capacity and system classes for various channel separation

Channel separation (MHz)	Channel arrangement ⇨		Co-polar (ACCP)								Co-polar (ACCP/CCDP)		Cross-polar (ACAP)					
	Nominal payload bit rate (Mbit/s) ⇨		2	2 × 2	8	2 × 8	34	2 × 34	STM-0	2 × STM-0	STM-1 (ACCP) 2 × STM-1 (CCDP)	2 × STM-1 (ACCP) STM-4/ 4 × STM-1 (CCDP) (note 2)	STM-0	2 × STM-0	STM-1	2 × STM-1 (note 2)	4 × STM-0/ 5 x 34	8 × STM-0/ 10 x 34
	Class	System (band)⇩																
	1 (note 3)	E.5 (50 GHz)	7	14	28	-	-	-	-	-	-	-	-	-	-	-	-	-
		E.6 (52 GHz) E.7 (55 GHz)	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	E.5 (50 GHz)	3,5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		E.6 (52 GHz) E.7 (55 GHz)	-	7	14	28	56	-	-	-	-	-	-	-	-	-	-	-
	2	E.1 (23 GHz) E.2 (26, 28 GHz) E.3 (31, 32, 38 GHz) E.6 (52 GHz) E.7 (55 GHz)	3,5 (note 1)	3,5	7	14	28	56	-	-	-	-	-	-	-	-	-	-
		E.5 (50 GHz)	-	3,5	7	14	28	-	-	-	-	-	-	-	-	-	-	-
	3	E.6 (52 GHz) E.7 (55 GHz)	-	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-
	4L	E.1 (23 GHz) E.2 (26, 28 GHz) E.3 (31, 32, 38 GHz)	-	-	3,5	7	14	28	28 (note 1)	-	56	-	14	28	-	-	-	-
		E.6 (52 GHz) E.7 (55 GHz)	-	-	3,5	7	14	28	-	-	56	-	14	28	-	-	-	-
	4H	E.1 (23 GHz) E.2 (26, 28 GHz) E.3 (31, 32, 38 GHz)	-	-	-	-	-	-	-	28	-	-	-	-	-	-	-	-
	5A	E.1 (23 GHz) E.2 (26, 28 GHz) E.3 (31, 32, 38 GHz)	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	-
		E.4 (23, 26, 28, 32, 38 GHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	56	-	-
	5B	E.1 (23 GHz) E.2 (26, 28 GHz) E.3 (31, 32, 38 GHz)	-	-	-	-	7	14	-	-	28	-	-	-	-	-	-	-
		E.4 (23, 26, 28, 32, 38 GHz)	-	-	-	-	-	-	-	-	-	56	-	-	-	-	-	-
	6A	E.1 (23 GHz) E.2 (26, 28 GHz) E.3 (31, 32, 38 GHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	56

NOTE 1: These class 2 (2 Mbit/s) in 3,5 MHz and class 4L (STM-0) in 28 MHz systems are more typical of class 1 (2 Mbit/s) and class 3 (STM-0) systems, however, they are justified through the use of a more stringent adjacent channel interference requirement.

NOTE 2: Each carrier is considered to be a separate 2 × STM-1 system. STM-4/4 × STM-1 applications, besides CCDP frequency reuse of ACCP, may be implemented through the use of two 2 × STM-1 systems (ACCP or ACAP) on two separate 56 MHz channels that, due to spectrum availability, may not be adjacent.

NOTE 3: These systems show a spectral efficiency which is ~1/2 of that achieved by conventional class 1 systems.

E.3 Transmitter

E.3.1 General requirements

Table E.3: Transmitter requirements

Requirements	System E.1	System E.2	System E.3	System E.4	System E.5	System E.6	System E.7
Maximum transmitter power	Clause 4.2.1						
Nominal transmitter power tolerance (±B dB)	±B = ±2 dB		±B = ±3 dB	±B = ±2 dB (23, 26, 28 GHz bands) ±B = ±3 dB (31, 32, 38 GHz bands)	±B = ±3 dB		
Transmitter power and frequency control	Clause 4.2.1						
RF Spectrum mask	RF spectral density mask in clause E.3.2						
Discrete CW components exceeding the spectrum mask and other spectral lines	Clause 4.2.5						
Spurious emissions-external	Clause 4.2.6						
Radio frequency tolerance	±XX = ±15 ppm	±XX = ±20 ppm	±XX = ±15 ppm	±XX = ±15 ppm	±XX = ±10 ppm (class 2 equipment) ±XX = ±20 ppm (class 1 equipment)	±XX = ±15 ppm	±XX = ±15 ppm

E.3.2 RF spectrum masks

Spectrum masks are not inclusive of an allowance for radio frequency tolerance. Centre frequency f0 identifies the actual carrier frequency; the masks shall be extended up to 2,5 times the relevant CS of each system.

Tables E.4 to E6, with reference to the relevant generic mask specified in clause 4.2.4.1, show the offset frequency from f0 and attenuation of other discreet points on the spectrum mask.

NOTE: In some cases the tables provide two options labelled as "unified" and "alternative"; the latter being the one carried over from "historic" ENs now superseded, while the first derives from a more recent action of overall rationalization and unification among the various bands, channel separation and spectral efficiency classes.

E.3.2.1 Systems E.1, E.2, E.3 and E.4

Table E.4: Limits of spectral power density for bands from 23 GHz to 28 GHz

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)	K6 (dB)	f6 (MHz)
E.1 (23 GHz) E.2 (26 GHz) (28 GHz)	2	2 (note)	3,5	Figure 4	+1	1,3	-23	2	-23	2,3	-45	4,3				
		2 × 2	3,5			1,4		2,8		3,5		7				
		8	7			2,8		5,6		7		14				
		2 × 8	14			5,6		11,2		14		28				
		34	28 (unified)			12,8		16,4		25		45				
			28 (alternative)			11		19		25		45				
		2 x 34	56			25,6		32,8		50		90				
	4L	8	3,5	Figure 4	+1	1,4	-30	2,8	-35	3,5	-50	6,15				
		2 × 8	7			2,8		5,6		7		12,25				
		34	14			5,6		11,2		14		24,5				
		2 × 34	28 (alternative)			11,2		22,4		28		49				
			28 (unified)			12,8	-27	17		28		49				
		STM-1	56 (alternative)	Figure 4		22,5	-30	33	-35	65	-50	74				
			56 (unified)	Figure 4		25,6	-27	34	-35	56	-50	98				
		STM-0 (note)	28	Figure 5		7,5	-10	10,5	-30	12,5	-35	22	-50	30		
		STM-0	14 (ACAP)	Figure 4		7	-30	9,5	-35	14	-50	24,5				
		2 × STM-0	28 (ACAP)	Figure 4		14		19		28		49				
	4H	2 × STM-0	28 (ACCP)	Figure 5	+1	12	-10	15	-33	16,8	-40	35	-50	48,3		
	5A	STM-1	28	Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	-50	47
	5B	34	7	Figure 6	+2	3	-10	3,625	-32	3,875	-36	4,25	-45	10	-50	11,75
		2 × 34	14			6		7,25		7,75		8,5		20		23,5
		STM-1	28			12		14,5		15,5		17		40		47
	6A	4 x STM-0/ 5 x 34	28	Figure 6	+2	12,5	-10	15	-32	17	-35	20	-45	40	50	47
		8 x STM-0/ 10 x 34	56			25		30		34		40		80		94
E.4 (23, 26 and 28 GHz)	5A	2 × STM-1	56	Figure 6	+2	25	-10	30	-32	34	-35	40	-45	80	-50	94
	5B	2 × STM-1	56	Figure 6	+2	24	-10	29	-32	31	-36	34	-45	80	-50	94

NOTE: See also note 2 to table E.10.

Table E.5: Limits of spectral power density for bands 31 GHz, 32 GHz and 38 GHz

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)	K5 (dB)	f5 (MHz)
E.3 (31 GHz) (32 GHz) (38 GHz)	2	2 (note)	3,5	Figure 4	+1	1,3	-23	2	-23	2,3	-45	4,3		
		2 × 2	3,5			1,4		2,8		3,5		7		
		8	7			2,8		5,6		7		14		
		2 × 8	14			5,6		11,2		14		28		
		34	28 (unified)			12,8		16,4		25		45		
			28 (alternative)			11		19		25		45		
		2 x 34	56			25,6		32,8		50		90		
	4L	8	3,5	Figure 4	+1	1,4	-30	2,8	-35	3,5	-45	5,25		
		2 × 8	7			2,8		5,6		7		10,5		
		34	14			5,6		11,2		14		21		
		2 × 34	28 (alternative)			11,2		22,4		28		42		
			28 (unified)			12,8	-27	17						
		STM-1	56 (alternative)	Figure 4		22,5	-30	33		65		71		
			56 (unified)	Figure 4		25,6	-27	34		56		84		
		STM-0 (note)	28	Figure 5		7,5	-10	10,5	-30	12,5	-35	22	-45	27,5
		STM-0	14 (ACAP)	Figure 4		7	-30	9,5	-35	14	-45	21		
		2 × STM-0	28 (ACAP)			14		19		28		42		
	4H	2 × STM-0	28 (ACCP)	Figure 5	+1	12	-10	15	-33	16,8	-40	35	-45	41,7
	5A	STM-1	28	Figure 5	+2	12,5	-10	15	-32	17	-35	20	-45	40
	5B	34	7	Figure 5	+2	3	-10	3,625	-32	3,875	-36	4,25	-45	10
		2 × 34	14			6		7,25		7,75		8,5		20
		STM-1	28			12		14,5		15,5		17		40
	6A	4 x STM-0/ 5 x 34	28	Figure 5	+2	12,5	-10	15	-32	17	-35	20	-45	40
		8 x STM-0/ 10 x 34	56			25		30		34		40		80
E.4 (32 GHz) (38 GHz)	5A	2 × STM-1	56	Figure 5	+2	25	-10	30	-32	34	-35	40	-45	80
	5B	2 × STM-1	56	Figure 5	+2	24	-10	29	-32	31	-36	34	-45	80
NOTE: See also note 2 to table E.10.														

E.3.2.2 Systems E.5, E.6 and E.7

Table E.6: Limits of spectral power density

System	Spectrum efficiency class	Nominal bit rate (Mbit/s)	Channel separation (MHz)	Mask reference shape	K1 (dB)	f1 (MHz)	K2 (dB)	f2 (MHz)	K3 (dB)	f3 (MHz)	K4 (dB)	f4 (MHz)
E.5 (50 GHz)	1 (see note 1)	2	7	Figure 4	0	2,6	-25	5,2	-25	6,4	-45	10,4
		2 × 2	14			5,2		10,4		12,8		20,8
		8	28			10,5		19		24,5		35,5
	1	2	3,5	Figure 4	0	1,3	-25	2,6	-25	3,2	-45	5,2
	2	2 × 2	3,5	Figure 4	0	1,3	-25	2,6	-25	3,2	-45	5,2
		8	7			2,6		5,2		6,4		10,4
		2 × 8	14			5,2		10,4		12,8		20,8
		34	28			10,5		19		24,5		35,5
E.6 (52 GHz) E.7 (55 GHz)	1 (see note 1)	2	7	Figure 4	+1	3,3	-25	6,1	-25	6,8	-45	12,8
	1	2 × 2	7	Figure 4	+1	3,3	-25	6,1	-25	6,8	-45	12,8
		8	14			6		11,6		13		22
		2 × 8	28			12		24,2		26		45
		34	56			24		50		60		80
	2	2	3,5 (note 2)	Figure 4	+1	1,3	-23	2	-23	2,3	-45	4,3
		2 × 2	3,5			1,4		2,8		3,5		7
		8	7			2,8		5,6		7		14
		2 × 8	14			5,6		11,2		14		28
		34	28 (unified)			12,8		16,4		25		45
			28 (alternative)			11		19		25		45
		2 x 34	56			25,6		32,8		50		90
	3	STM-0	28	Figure 4	+1	10,5	-30	18	-35	28	-45	33
	4L	8	3,5	Figure 4	+1	1,4	-30	2,8	-35	3,5	-45	5,85
		2 × 8	7			2,8		5,6		7		11,67
		34	14			5,6		11,2		14		23,35
		2 × 34	28 (alternative)			11,2		22,4		28		46,7
			28 (unified)			12,8	-27	17				
		STM-1	56 (alternative)	Figure 4	+1	22,5	-30	33	-35	65	-45	75
			56 (unified)	Figure 4	+1	25,6	-27	34	-35	56	-45	84
		STM-0	14 (ACAP)	Figure 4	+1	7	-30	9,5	-35	14	-45	23,35
		2 × STM-0	28 (ACAP)			14		19		28		46,7

NOTE 1: These systems show a spectral efficiency which is ~1/2 of that achieved by conventional class 1 systems.
NOTE 2: See also note 2 to table E.10.

E.4 Receiver

E.4.1 General requirements

Table E.7: Receiver requirements

Requirements	Systems E.1, E.2 and E.3	SystemE.4	Systems E.5, E.6 and E.7
Spurious emissions (external)	Clause 4.3.1		
BER as a function of RSL	Table E.8a	Table E.8b	Table E.9
Co channel external and adjacent channel interference sensitivity	Table E.10		
CW spurious interference	Clause 4.3.4		

E.4.2 BER as a function of Receiver input Signal Level (RSL)

The supplier shall declare the RSL threshold(s) (dBm) for the relevant BER values (i.e. 10^{-6} and 10^{-8} or 10^{-10}), which shall not be worse than the corresponding RSL upper bound values indicated in the tables E.8a, E.8b and E.9. The declared Receiver Signal levels shall produce a BER of either $\leq 10^{-6}$ or $\leq 10^{-8}$ as required.

NOTE: RSL values, evaluated for typical implementation practice, may be found in TR 101 854 [i.26]

E.4.2.1 Systems E.1, E.2, E.3 and E.4

Table E.8a: BER performance thresholds for 23 GHz to 38 GHz bands (systems E.1, E.2 and E.3) (upper bound)

		System →	E.1		E.2		E.3			
		Band →	23 GHz band		26 GHz and 28 GHz bands		31 GHz and 32 GHz band		38 GHz band	
Spectrum efficiency class	Bit rate (Mbit/s)	Channel separation (MHz)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)
2	2	3,5 (note)	-86,5	-84	-85	-82	-84	-81	-82,5	-80
	2 × 2	3,5	-83,5	-81	-82	-79	-81	-78	-79,5	-77
	8	7	-80,5	-78	-79	-76	-78	-75	-76,5	-74
	2 × 8	14	-77,5	-75	-76	-73	-75	-72	-73,5	-71
	34	28	-74,5	-72	-73	-70	-72	-69	-70,5	-68
	2 x 34	56	-71,5	-69	-70	-67	-68	-66	-67,5	-65
4L	8	3,5	-76,5	-74	-76	-74	-75	-72	-72,5	-70
	2 × 8	7	-73,5	-71	-73	-71	-72	-69	-69,5	-67
	34	14	-70,5	-68	-70	-68	-69	-66	-66,5	-64
	2 × 34	28	-67,5	-65	-67	-65	-66	-63	-63,5	-61
	STM-0	28 (note)	-71,5	-69	-72	-70	-70	-67	-67,5	-65
	STM-1	56	-66,5	-64	-67	-65	-65	-63	-62,5	-60
	STM-0	14 (ACAP)	-69,5	-67	-69	-67	-68	-65	-65,5	-63
	2 × STM-0	28 (ACAP)	-66,5	-64	-66	-64	-65	-62	-62,5	-60
4H	2 × STM-0	28 (ACDP)	-66,5	-64	-66	-64	-65	-62	-62,5	-60
5A	STM-1	28	-63	-61	-62	-60	-61	-59	-60	-58
5B	34	7	–69	–67	–68	–66	–67	–65	–66	–64
	2 × 34	14	-66	-64	-65	-63	-64	-62	-63	-61
	STM-1	28	-63	-61	-62	-60	-61	-59	-60	-58
6A	4 × STM-0/ 5 × 34	28	-57	-55	-56	-54	-55	-53	-54	-52
	8 x STM-0/ 10 x 34	56	-54	-52	-53	-51	-52	-50	-51	-49
NOTE: See also note 2 to table E.10.										

Table E.8b: BER performance thresholds for 23 GHz to 38 GHz bands (system E.4) (upper bound)

		System →	E.4							
		Band →	23 GHz band		26 GHz and 28 GHz bands		32 GHz band		38 GHz band	
Spectrum efficiency class	Bit rate (Mbit/s)	Channel separation (MHz)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)
5A	2 × STM-1	56 (ACAP)	-59	-57	-58	-56	-57	-55	-56	-54
5B	2 × STM-1	56 (ACCP/CCDP)								

E.4.2.2 Systems E.7, E.5 and E.6

Table E.9: BER performance thresholds for 50 GHz to 55 GHz (systems E.7, E. 5 and E.6) (upper bound)

		System	E.5	E.6 and E.7	
		Band	50 GHz	52 GHz and 55 GHz	
Spectrum efficiency class	Bit rate (Mbit/s)	Channel separation (MHz)	RSL for BER ≤ 10^{-6} (dBm) (note 1)	RSL for BER ≤ 10^{-6} (dBm)	RSL for BER ≤ 10^{-8} (dBm)
1 (note 2)	2	7	-72	-80,5	-78
	2 × 2	14	-69	-	-
	8	28	-66	-	-
1	2	3,5	-78	-	-
	2 × 2	7	-	-80,5	-78
	8	14	-	-77,5	-75
	2 × 8	28	-	-74,5	-72
	34	56	-	-71,5	-69
2	2	3,5 (note 3)	-	-80,5	-78
	2 × 2	3,5	-75	-77,5	-75
	8	7	-72	-74,5	-72
	2 × 8	14	-69	-71,5	-69
	34	28	-66	-68,5	-66
	2 x 34	56	-	-65,5	-63
3	STM-0	28	-	-65,5	-63
4L	8	3,5	-	-70,5	-68
	2 × 8	7	-	-67,5	-65
	34	14	-	-64,5	-62
	2 × 34	28	-	-61,5	-59
	STM-1	56	-	-60,5	-58
	STM-0	14 (ACAP)	-	-63,5	-61
	2 × STM-0	28 (ACAP)	-	-60,5	-58
4H	2 × STM-0	28 (ACDP)	-	-60,5	-58

NOTE 1: For system E.5, only the RSL for BER ≤ 10^{-6} is standardized; however, in a previously published EN these systems were also required to meet a specific RSL for BER ≤ 10^{-3}, which were set 3 dB lower than the RSL for BER ≤ 10^{-6}. This information may be used for deriving a typical RSL versus BER curve.

NOTE 2: These systems show a spectral efficiency which is ~1/2 of that achieved by conventional class 1 systems.

NOTE 3: See also note 2 to table E.10.

E.4.3 Co-channel "external" and adjacent channel interference sensitivity

The limits of Carrier to Interference ratio (C/I) in case of co-channel and adjacent channel interference shall be as in table E.10, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits declared for BER $\leq 10^{-6}$ in clause E.4.2.

Table E.10: Co-channel and adjacent channel interference sensitivity

				C/I for BER ≤ 10^{-6} RSL degradation of 1 dB or 3 dB			
				Co-channel interference		Adjacent channel interference	
Spectrum efficiency class	**System**	**Nominal bit rate (Mbit/s)**	**Channel separation (MHz)**	**1 dB**	**3 dB**	**1 dB**	**3 dB**
1 (note 1)	**E.5, E.6, E.7**	**2**	**7**	23	19	0	-4
	E.5	**2 × 2**	**14**	23	19	0	-4
		8	**28**	23	19	0	-4
1	**E.5**	**2**	**3,5**	23	19	0	-4
	E.6, E.7	**2 × 2**	**7**	23	19	0	-4
		8	**14**	23	19	0	-4
		2 × 8	**28**	23	19	0	-4
		34	**56**	23	19	0	-4
2	**E.1, E.2, E.3, E.6, E.7 (note 2)**	**2**	**3,5**	23	19	-3	-7
	E.1, E.2, E.3 E.5, E.6, E.7	**2 × 2**	**3,5**	23	19	0	-4
		8	**7**	23	19	0	-4
		2 × 8	**14**	23	19	0	-4
		34	**28**	23	19	0	-4
	E.1, E.2, E.3, E.6	**2 x 34**	**56**	23	19	0	-4
3	**E.6, E.7**	**STM-0**	**28**	23	19	-1	-5
4L	**E.1, E.2, E.3 E.6, E.7**	**8**	**3,5**	30	26	-1	-5
		2 × 8	**7**	30	26	-1	-5
		34	**14**	30	26	-1	-5
		2 × 34	**28**	30	26	-1	-5
		STM-1	**56**	30	26	-1	-5
		STM-0	**14 (ACAP)**	30	26	-1	-5
		2 × STM-0	**28 (ACAP)**	30	26	-1	-5
	E.1, E.2, E.3 (note 2)	**STM-0**	**28**	30	26	-10	-13,5
4H	**E.1, E.2, E.3**	**2 × STM-0**	**28 (ACCP)**	30	26	-6	-9,5
5A	**E.1, E.2, E.3**	**STM-1**	**28**	37	33	+3	-1
	E.4	**2 × STM-1**	**56**	37	33	+3	-1
5B	**E.1, E.2, E.3**	**34**	**7**	37	33	–3	–7
		2 × 34	**14**	37	33	-3	-7
		STM-1	**28**	37	33	-3	-7
	E.4	**2 × STM-1**	**56**	37	33	-3,5	-7,5
6A	**E.1, E.2, E.3**	**4 x STM-0/ 5 x 34**	**28**	41	38	10	7
		8 x STM-0/ 10 x 34	**56**	41	38	10	7

NOTE 1: These systems show a spectral efficiency which is ~1/2 of that achieved by conventional class 1 systems.
NOTE 2: These class 2 (2 Mbit/s) in 3,5 MHz and the class 4L (STM-0) in 28 MHz are more typical of a class 1 (2 Mbit/s) and class 3 (STM-0) systems, however, they are justified by the use of a more stringent adjacent channel interference requirement.

Annex F (normative): Transmission of packet data and combinations of other signals in bands from 3 GHz to 55 GHz

F.1 Introduction

This annex provides the conditions under which the existing PDH/SDH specifications can be used for systems with traffic interface combinations other than those mentioned in the PDH/SDH specifications when mapped into proprietary transport modules (i.e. not mapped into conventional standardized PDH or SDH transport modules).

F.2 General characteristics

F.2.1 Frequency characteristics and channel arrangements

The equipment shall operate on frequency bands and channels arrangements in accordance with information provided in the relevant annexes.

F.2.2 Transmission capacities

It is recognized that equipment transmitting flexible packet data (e.g. Ethernet signals) offers the user benefits that goes beyond the mere spectrum efficiency. For this reason and due to the fact that Ethernet interfaces (e.g. 10/100/1 000 baseT) hardly fit in the conventional PDH/SDH hierarchies, a sensible relaxation of the permitted minimum RIC is justified.

For assessing such equipment against essential parameters under article 3.2 of R&TTE Directive [1], it is necessary to select the set of equipment characteristics relevant to the channel separation and the equipment classes of an equivalent PDH/SDH rate for the same frequency band from the referenced annexes A to E of the present document. In order to facilitate spectral efficiency, the selection shall be made by comparing the minimum required *Radio Interface Capacities* (RIC) with those conventional PDH/SDH rates defined in table F.1.

Only systems with RIC equal to or higher than the minimum RIC in table F.1 may, therefore, adopt in the assessment the equivalent PDH/SDH equipment characteristics (for the same channel separation and equipment class).

It should also be noted that regulating only the minimum RIC the actual system may fulfil requirements for more than one class, provided that they are capable of meeting all the requirements, e.g. the two different spectrum masks. The supplier may choose which class to declare.

Table F.1: Applicable PDH/SDH specifications for accumulated capacities using a combination of interfaces

Equivalent PDH/SDH rate (Mbit/s)	Minimum applicable RIC (Mbit/s)
2,048	1,3
N × 2,048	N x 1,35
8,448	5,5
N × 8,448	N x 5,55
34,368	22,2
STM-0	33,3
N × 34,368	N x 22,2
N × STM-0	N x 33,3
STM-1	100
N × STM-1	N × 100

F.3 System parameters

There are no essential requirements under the R&TTE Directive [1] specific to radio systems with packet data interfaces.

All radio requirements shall be taken from an appropriate PDH or SDH specification as defined in table F.1. This clause describes how to apply the appropriate PDH/SDH specification to a radio system with a combination of interfaces.

The supplier shall declare the Radio Interface Capacity (RIC). The Radio Interface Capacity (RIC) must exceed the minimum RIC given in table F.1 to allow the application of a specific PDH/SDH annex.

In addition, the Network Interface Capacity (NIC) must be equal to or exceed the Radio Interface Capacity (RIC) to allow application of a specific PDH/SDH annex from table F.1.

F.3.1 Transmitter

All requirements, defined in the annex and selected according table F.1, are applicable to the same channel separation for the same class of equipment.

F.3.2 Receiver

All requirements, defined in the annex selected according table F.1, are applicable with the same channel separation for the same class of equipment provided that BER tests may be substituted by the equivalent FER as defined in clause F.3.3.

F.3.3 FER as a function of BER

In the event that no PDH/SDH interface is available at base band level (reference points X, X' of figure 1 of EN 302 217-1 [6]), and no other mean (even proprietary ones) are possible for a true bit-to-bit error count at reference point X, this clause describes how to translate the BER requirements from the PDH/SDH specification to verify compliance of the radio system when such a combination of interfaces includes (as a minimum) an Ethernet interface.

The supplier shall describe how to load the system with the Radio Interface Capacity (RIC), possibly using multiple interfaces. The error rates specified in the PDH/SDH specification shall be met on all traffic loading the system. The traffic may contain combinations of PDH, SDH, packet data or other signals. For Ethernet interfaces, the BER requirements in the PDH/SDH standard shall be converted to FER requirements using table F.2 (based on 64 octet frames).

Table F.2: Conversion between Bit Error Rate (BER) and Frame Error Rate (FER)

BER	FER
10^{-6}	5×10^{-4}
10^{-8}	5×10^{-6}
10^{-10}	5×10^{-8}
10^{-12}	5×10^{-10}

Automatic Repeat Request (ARQ) algorithms may also be used as an error correction method.

Additional information with respect to the derivation of the BER/FER relationship and testing examples may be found in annex G of EN 302 217-2-1 [i.24].

In the event that an Ethernet interface is not offered, but other standardized interfaces are used, the supplier shall declare an equivalent conversion table supported by technical evidence (of its appropriateness).

Annex G (normative): Test report in relation to flexible systems applications

G.1 Wide radio-frequency band covering units

Even if radio frequency front-ends for DFRS are commonly designed for covering all or part(s) of the possible operating channels within a specific radio frequency channel arrangement, equipments can provide single radio frequency channel operation (e.g. when the RF duplexer filters are tuned to a specific channel) or offer a wider operating frequency range (e.g. wide-band RF duplexer and frequency agility through the use of a RFC function. Ease of deployment and spare parts handling by operators with large networks is facilitated where more than one channel is assigned).

The equipment shall comply with all the requirements of the present document at any possible operating frequency.

The tests, carried out to generate the test report and/or declaration of conformity, required to fulfil any conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out in the following way:

1) In the case of equipments intended for single channel operation, the test report shall be produced for one radio frequency channel arbitrarily chosen by the supplier (see figure G.1).

2) In the case of equipments intended for covering an operating frequency range, the test report shall be produced:

   - on the transmitter side, for the lowest, intermediate and highest possible radio frequency channel within that operating frequency range (see figure G.2);

   - on the receiver side, for the lowest, intermediate and highest possible radio frequency channel within that operating frequency range only for Spurious emissions - external and BER as a function of RSL parameters. Other essential parameters on receiver side have to be tested for the intermediate radio frequency channel only.

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 channel frequencies or frequency ranges and at different times (see note).

NOTE: It should be noted that, in principle, all tests are carried on the same equipment in a single test session. However, the allowance for different test sessions and equipment under test is made to cope with unpredictable events (e.g. equipment or test instruments failure during the tests, not immediately repairable) or for future revision of the present document that might introduce new or different requirement due for additional tests report. In any case this allowance is not intended as a possibility to overcome failed tests without corrective actions.

When applicable the following additional provisions apply to the production of a test report:

- In the case of equipments covering a radio frequency channel arrangement with more than one operating frequency range, the test report shall be produced for one of the operating frequency ranges arbitrarily chosen by the supplier, using the above procedures for equipments intended for single channel operation or for covering an operating frequency range (see figure G.1).

- In the case of equipments designed to cover, with the same requirements under the same ETSI standard, a number of fully or partially overlapping recommended and/or national radio frequency channel arrangements, similarly established across contiguous radio frequency bands allocated to the Fixed Service, the test report shall be produced for one radio frequency channel arrangement arbitrarily chosen by the supplier, using the above procedures for equipments intended for single channel operation or for covering an operating frequency range (see figures G.1 and G.2).

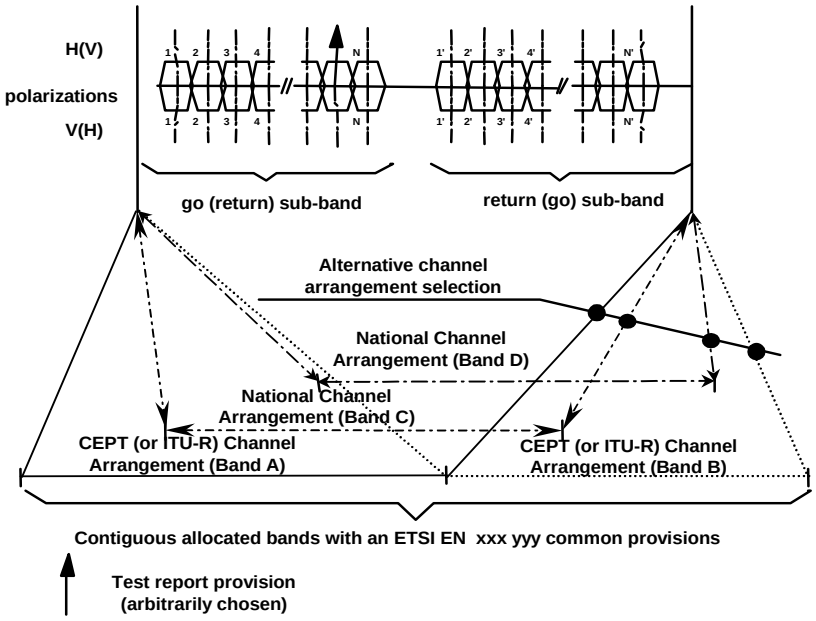


Figure G.1: Test report frequency requirement for equipments intended for single channel operation

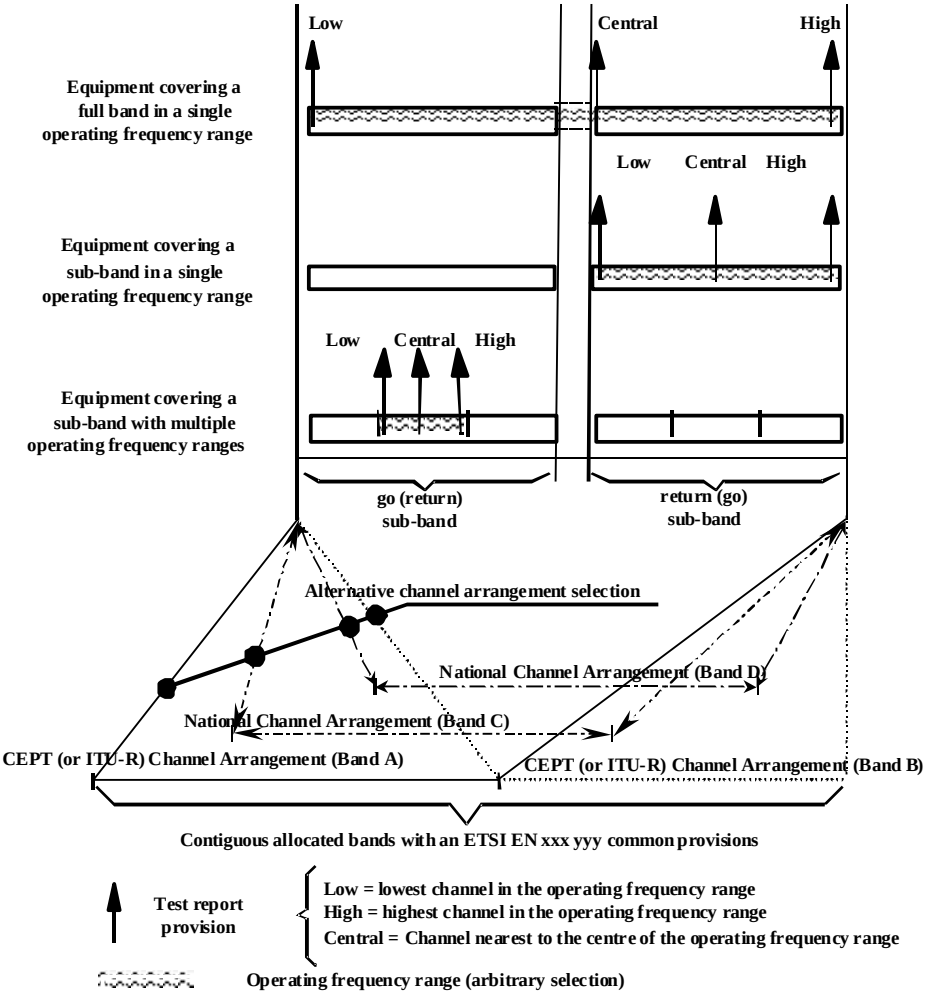


Figure G.2: Test report frequency requirements for equipments intended for covering an operating frequency range

G.2 Multirate/multiformat equipment

DFRS equipments can be designed either for a unique payload and modulation format (*Single-mode* systems) or for covering a number of different payload-rates ("*multirate"* systems as defined in EN 302 217-1 [6]) or different modulation formats (i.e. different equipment classes) or different error correction codes transmitted, through software presettings or protocols, over a number of different channel separations.

In the latter case, within a certain ChS, the payload and modulation presettings may offer static operation over different payload/modulation (*Preset-mode* systems) or dynamic operation changing payload/modulation (*Mixed-mode* systems) according network requirements (e.g. propagation variations).

For *preset-mode* systems the equipment shall comply with all the requirements of the present document at any possible combination of operating payload, modulation and codes declared.

The tests, carried out to generate the test report and/or declaration of conformity, required to fulfil any Conformity assessment procedure with respect to the R&TTE Directive [1], shall be carried out for transmitting phenomena (see clause 4.2) at any possible bit rate and modulation format, while receiving phenomena (see clause 4.3) shall be tested only at the lowest and the highest bit rate for any modulation format.

Mixed-mode systems, besides specific Dynamic Change of Modulation Order test referred in clause 5.2.7, are to be tested, for each *reference-mode* offered only (see note), as *preset-mode* systems (i.e. dynamic operation in *mixed-mode* systems shall be disabled for all other tests).

NOTE: *Mixed-mode* systems might use a number of modes (e.g. BPSK/4/16/32/64/128/256 QAM) in dynamic operations but, for technical/operational convenience only few modes might be available as "*reference*" (e.g. only 4/16/128 QAM may find suitable assessment characteristics in the present document); therefore, only the latter ones are relevant for static (*preset-mode* like) operation conformance test.

G.3 BER measurement in a SDH multi-interface, multi-carrier system

This clause deals with systems that either have STM-4 or several STM-1 interfaces, two RF carriers (2 × STM-1 each) or a combination of these characteristics. In order to keep the requirements set out in the standard aligned with single carrier single interface standards, there is a need to modify the basic requirements according to the system type. BER and performance measurements need to take into consideration the system type and configuration. The purpose of this annex is to provide guidance for measurement and planning of these systems.

G.3.1 Case 1: multi-interface 2 × STM-1/single carrier or multi-interface, 4 × STM-1/two-carrier systems where each STM-1 payload is transmitted on one carrier only

Test equipment will be connected to one of the STM-1 interfaces. The resulting BER shall comply with the requirements in the standard.

Since each STM-1 signal is transmitted on one single carrier, all measurements of performance are in general identical to other single interface, single carrier systems.

G.3.2 Case 2: single interface, STM-4/two-carrier system

Test equipment will be connected to the STM-4 interface. The resulting BER shall comply with the requirements in the standard as described in table G.1.

Table G.1: BER for single interface STM-4/two carrier system

Clause	Measurement	Test method	BER requirement
4.3.2	BER vs. RSL	Both carriers Simultaneously	As specified
4.3.3 and 4.3.4	External Co-channel and adjacent channel Interference	The RSL is set on both carriers at the 10^{-6} threshold, as specified in clause 5.5.1. The interferer and the 1 dB (3 dB) degradation is applied to one carrier only	As specified

G.3.3 Case 3: multi-interface 4 × STM-1/two-carrier system where each STM-1 payload is transmitted on both carriers

Test equipment will be connected to one of the STM-1 interfaces. The resulting BER shall comply with the requirements in the standard as described in table G.2.

Table G.2: BER for multi-interface 4 × STM-1/two carrier system

Clause	Measurement	Test method	BER requirement
4.3.2	BER vs. RSL	Both carriers	As specified
4.3.3 and 4.3.4	Co-channel and adjacent channel Interference	The RSL is set on both carriers at the 10^{-6} threshold, as specified in 5.5.1. The interferer, together with the 1 dB (3 dB) degradation is applied on one carrier at a time, on both carriers (two measurements)	As specified (see note). Compliance to the limits shall be guaranteed during both measurements
NOTE: The 10^{-6} threshold degradation shall be obtained as a sum, on the same STM-1 interface, during the two measurements, therefore the BER limits shall be modified accordingly (e.g. twice 5×10^{-7} instead of 1×10^{-6}). For planning purposes, please note that if there is interference on both carriers, the resulting BER will be 1×10^{-6}.			

Annex H (normative): HS Requirements and conformance Test specifications Table (HS-RTT)

The HS Requirements and conformance Test specifications Table (HS-RTT) in table H.1 serves a number of purposes, as follows:

- it provides a statement of all the essential requirements in words and by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document;
- it provides a statement of all the test procedures corresponding to those essential requirements by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it qualifies each requirement to be either:
  - Unconditional: meaning that the requirement applies in all circumstances; or
  - Conditional: meaning that the requirement is dependent on the manufacturer having chosen to support optional functionality defined within the schedule.
- in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;
- it qualifies each test procedure to be either:
  - Essential: meaning that it is included with the Essential Radio Test Suite and therefore the requirement shall be demonstrated to be met in accordance with the referenced procedures;
  - Other: meaning that the test procedure is illustrative but other means of demonstrating compliance with the requirement are permitted.

Table H.1: HS Requirements and conformance Test specifications Table (HS-RTT)

Harmonized Standard EN 302 217-2-2 The following requirements and test specifications are relevant to the presumption of conformity under article 3.2 of the R&TTE Directive						
Requirement			**Requirement Conditionality**		**Test Specification**	
No	**Description**	**Reference: Clause No (see note)**	**U/C**	**Condition**	**E/O**	**Reference: Clause No**
1	Transmitter power	4.2.1	U		E	5.2.1
2	Transient behaviour of the transmitter - Automatic Transmit Power Control (ATPC)	4.2.2.1.1	C	Only applies if ATPC fitted	E	5.2.2.1.1
3	Adjacent channel power - Remote Transmit Power Control (RTPC)	4.2.2.1.2	C	Only applies if RTPC fitted	E	5.2.2.1.2
4	Transient behaviour of the transmitter - Remote Frequency Control (RFC)	4.2.2.2	C	Only applies if RFC fitted	E	5.2.2.1.3
5	Transmitter power tolerance	4.2.3	U		E	5.2.3
6	Adjacent channel power - Spectrum mask	4.2.4	U		E	5.2.4
7	Adjacent channel power - Discrete CW components exceeding the spectrum mask limit	4.2.5	U		E	5.2.5
8	Spurious emissions	4.2.6	U		E	5.2.6
9	Dynamic change of modulation order	4.2.7	C	Only applies to mixed-mode systems	E	5.2.7
10	Frequency error/stability	4.2.8	U		E	5.2.8
10	Off-axis EIRP density - Radiation Pattern Envelope (RPE)	4.4.1	C	Only applies to systems with integral antennas	E	5.4.1
11	Antenna gain	4.4.2	C		E	5.4.2
12	Antenna Cross-Polar Discrimination	4.4.3	C		E	5.4.3
13	Spurious emissions	4.3.1	U		E	5.3.1
14	BER as a function of receiver input signal level	4.3.2	U		E	5.3.2
15	Co-channel interference sensitivity	4.3.3	U		E	5.3.3
16	Adjacent channel interference sensitivity	4.3.3	U		E	5.3.3
17	CW Spurious interference (Blocking or desensitization inc. duplex)	4.3.4	U		E	5.3.4

Key to columns:

Requirement:

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

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 to be *unconditionally* applicable (U) or is *conditional* upon the manufacturers claimed functionality of the equipment (C).

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

Test Specification:

E/O Indicates whether the test specification forms part of the Essential Radio Test Suite (E) or whether it is one of the Other Test Suite (O).

NOTE: All tests whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement The completion of all tests classified "E" as specified with satisfactory outcomes is a necessary condition for a presumption of conformity. Compliance with requirements associated with tests classified "O" or "X" is a necessary condition for presumption of conformity, although conformance with the requirement may be claimed by an equivalent test or by manufacturer's assertion supported by appropriate entries in the technical construction file.

Clause Number Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly. Where no test is specified (that is, where the previous field is "X") this field remains blank.

Annex I (informative): Spectrum mask requirements when power control (ATPC and/or RTPC) or mixed-mode operation are concerned

It is worth explaining that, in most practical applications, ATPC and RTPC are realized by a single function SW programmable system; therefore it is the supplier that should declare how the available range of attenuation should be subdivided (and possibly limited) in order to meet the requirements described below.

I.1 ATPC impact

Among other, more stringent, requirement, set out in EN 302 217-2-1 [i.24] as "non essential" to fulfil article 3.2 of R&TTE Directive [1], figure I.1 clarifies the technical background for the ATPC minimum requirements that are considered "essential" (see note).

NOTE: Clause 4.2.2.1.1 states that "*The equipment shall comply with the requirements of spectrum masks in clause 4.2.4 with ATPC operating in the range between "maximum nominal power" and "maximum available power" including the attenuation introduced by the RTPC function (if any)*".

The Rationale for the requirement is that while the mask is a "relative attenuation", the actual interference potential is given by the absolute power spill-over into adjacent channels. Therefore the NFD should be guaranteed when transmitters operate at maximum nominal power or in the overdrive region (i.e. when maximum absolute power is produced in adjacent channels), which are the conditions commonly used for frequency planning. In all lower power conditions, even where the NFD may be degraded by the (apparent) increase of the noise floor (due to the actual drop in carrier power), resulting in the mask level being exceeded (see figure I.1), however the absolute interference power on adjacent channels will in any case be equal to or less than that used for planning (i.e. the planned C/I on adjacent channels will not be exceeded).

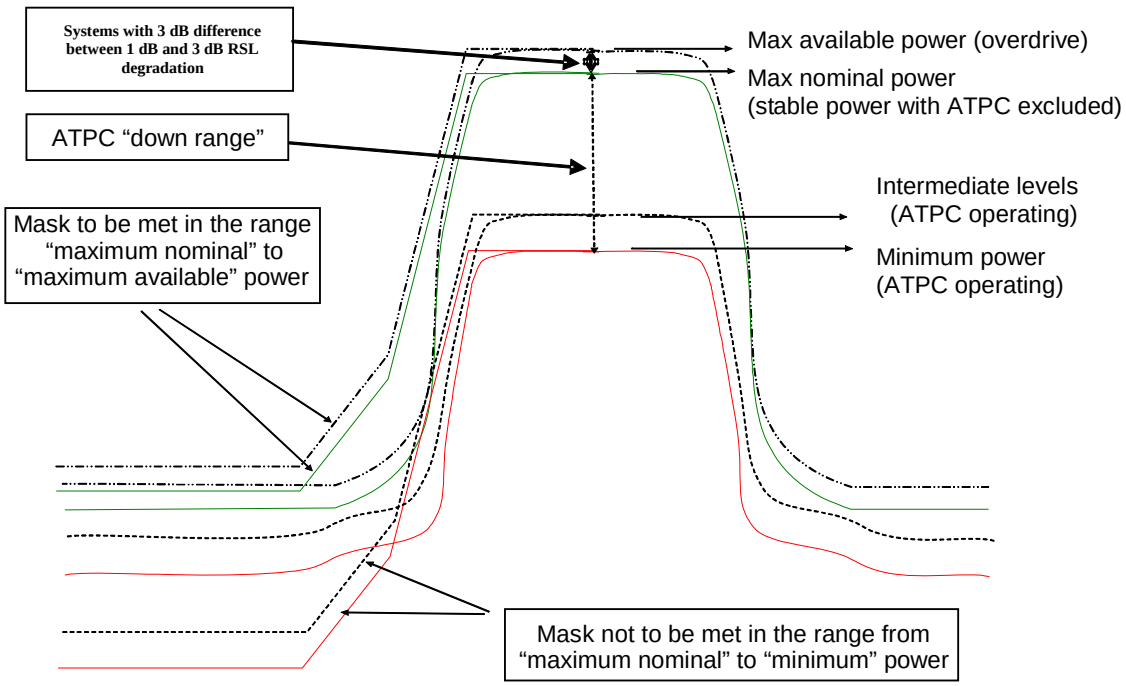


Figure I.1: Relationship between spectrum mask requirement and ATPC operation

However, it has to be considered that, besides the inter-system operation guaranteed by the above behaviour of the equipment, there is an intra-system constraints for maintaining a suitable RBER that should be taken into account in the system design; under ATPC operation, the "noise floor" of the emission should remain sufficiently low for maintaining a signal to noise ratio (S/N) suitable for RBER fulfilment. That S/N would depend on the proprietary implementation; however, a conservative indication may be drawn assuming that the ratio between the in-band power density and the noise density ("transmitter S/N") should be:

$$\text{Transmitter S/N (dB)} > (\text{Cochannel C/I@1dB}) + (\text{RSL@RBER} - \text{RSL@BER10}^{-6})$$

Where:

Cochannel C/I@1dB is defined in clause 4.3.3 and specified in relevant annexes.

The factor (RSL@RBER - RSL@BER10^{-6}) is defined as ≤ 10 dB in clause 6.5.1 of EN 302 217-2-1 [i.24].

I.2 RTPC Impact

It should be considered that, when RTPC is used as alternative for conventional RF attenuators (used in the past for a similar purpose) for setting the maximum power established in the network when planning for each single link (PP) or each cell (in Multi-Point (MP) applications) in order to restrict inter-system interference into other links/cells (of other operators only), the NFD should be maintained (because it is used for frequency planning and associated with a rated power). Therefore the mask should be met throughout the operating range offered (supplier should limit the range of RTPC accordingly).

However, there are differences between PP and MP to be taken into account:

a) PP: RTPC (if any) is used only for inter/link interference and link-budget balancing; therefore the above statement applies to all RTPC systems.

b) MP: RTPC (if any) might be used for two different purposes:

   b1) For inter-operators interference balancing (in particular but not limited to master stations); in this application it is similar to the PP one, therefore the same concept applies (mask should be met) (see note).

   b2) For intra-system power balancing of terminal stations close to the central station or for the shortest hops in Mesh architectures. In this case the masks do not need to be met because it is an intra system issue (interference balancing with other operators is done by taking account of the power levels associated with the most distant TSs).

NOTE: Rationale is that some CEPT SE19 recommendations and coexistence reports are made assuming a certain values of NFD for defining the guard-band. However, in cases when block-mask is defined, this is no longer necessary (e.g. in 40 GHz band). It should also be noted that no specific difference in this concept is identified between P-MP and Mesh architecture.

In conclusion, in MP systems, the RTPC should be subdivided in the supplier declaration in two different ranges (b1 and b2 above) and the mask should be met only in range b1.

I.3 Mixed-mode operation impact

I.3.1 Basic concepts

When assigned a radio frequency channel of a certain width over a link of defined length, the use of adaptive modulation (*mixed-mode*) in PP links can, in principle, while occupying the same channel, offer more efficient operative conditions dictated by two different optional objectives:

a) The increase the available capacity over the same radio frequency channel, during period with favourable propagation conditions, by the use of modulation formats higher than that used for defining the link budget and related frequency co-ordination constraints at the conventional availability objective (e.g. 99,99 %). Maintaining symbol rate about the same, this will result in the same channel occupancy and in a higher capacity even if with lower availability (according the statistic of propagation phenomena, multipath or rain) due to reduced link budget (according the higher BER threshold and reduced TX power for improving linearity).

EXAMPLE: On a link designed and frequency co-ordinated for the 99,99 % availability for 'K' Mbit/s capacity with 4QAM format, the system, maintaining the same symbol-rate, will also operate for:

'2*K' Mbit/s capacity with 16 QAM format for lower time % due to the ~10 dB reduction in link budget (i.e. ~6 dB S/N and ~4dB TX back-off) resulting, in Rayleigh multipath propagation, in ~99,9 %.

'3*K' Mbit/s capacity with 64 QAM format or '4*K' Mbit/s capacity with 256 QAM for even lower time %, due to the ~8 dB or ~ 15 dB further reduction in link budget (as a mixture of consequent S/N increase and TX back-off).

b) To increase the availability of a smaller portion of the capacity, during period with very unfavourable propagation conditions, by the use of modulation formats lower than that used for defining the link budget and related frequency co-ordination constraints at the conventional availability objective (e.g. 99,99 %). This will result in lower capacity with higher availability (according the statistic of propagation phenomena, multipath or rain) due to enhanced link budget (according the lower BER threshold and, as far as possible, TX power increase consequent to reduced linearity requirement).

EXAMPLE: On a link designed and frequency co-ordinated for 99,99 % availability for 'K' Mbit/s capacity and 64QAM format, the system, maintaining the same symbol-rate, will also operate for:

'2/3*K' Mbit/s capacity and 16 QAM format for higher time % due to the increase in link budget (i.e. ~6 dB S/N and, if possible, ~4dB TX back-off) resulting, in Rayleigh multipath propagation, in ~99,999 %.

'1/3*K' Mbit/s capacity and 4 QAM format for an even higher time %, due to the further increase in link budget (as a mixture of consequent S/N increase and, if possible, TX back-off).

Intermediate situations are possible; e.g. the link designed and co-ordinated with 16 QAM format might dynamically change to 64 QAM or higher for objectives in option a) and to 4 QAM or lower for objectives in option b).

It is to be noted that go and return channels may operate independently, being driven by different propagation situation; therefore TX and RX modulation formats, at a certain time, may not be the same.

In addition, it should be noted that *mixed-mode* systems will likely need highly reliable exchange of information between TX and RX, necessary for managing the change of format dynamically with propagation. For this purpose, it might be advisable that service channels for internal system management (e.g. within the headers of the radio frame, similarly to preambles in PMP systems) are always transmitted with symbols of the less sensitive format (e.g. 4QAM or even BPSK) even when the remaining radio frame (payload) is transmitted with symbols of higher order formats.

I.3.2 Implications on frequency co-ordination and possible regulatory background (licensing and fee)

However, the possible operative conditions described above, which in general implies from time to time the change of modulation format and TX output power, when applied on link by link frequency coordinated bands, should consider the constraints deriving from the licensed use of the spectrum.

These constraints are consequence of three possible reasons:

1) Frequency coordination is made on the basis of system parameters (i.e. TX spectrum mask and RX sensitivity) in a fixed size radiofrequency channel; therefore, while changing format and power, the system should not worsen the coordination assumptions (i.e. those of the reference mode) for not impairing coordination assumptions. However, different considerations are applicable to TX and RX parameters:

   - TX emission should not exceed that of the reference mode for not exceedingly affect neighbour systems in same or adjacent channels.

   - Receiver sensitivity to interference of different modulation formats is not an issue in PP links coordination (provided that noise figure is kept constant) because it is made on the basis of fixed channel separation and of a constant limited amount of interference (e.g. as defined in ECC/REC 01-05 for 'x' dB constant degradation of the noise floor on noise-limited links) from interfering channels into a fixed receiver bandwidth designed for that radio frequency channel. Therefore, whichever is the system mode of the receiver, the originally planned threshold degradation for the reference mode will remain unchanged for all modes.

2) In some cases and for some valuable bands, administrations might require a minimum spectral efficiency (e.g. minimum 16 states formats).

3) In some cases, the national administrative policy might foresee licensing fees depending also on the carried payload.

For suitably responding to these constraints, while leaving operative flexibility to the operator, the *mixed-mode* system operations should:

- Be licensed (i.e. in term of system and link parameters), in a fixed width radio frequency channel, for the format and capacity identified by the *reference-mode* (system type), with the desired "reference availability objective" (i.e. the typical 99,99 % or any other generally used by the administration concerned for the frequency coordination).

- Be left free, by licensing conditions, of using more complex formats and higher capacity, provided that they do not exceed the "reference mode" spectral emission, in term of both output power density and spectrum mask and (e.g. as in the 4 QAM "reference format" example shown in figure I.2) (see note).

- Be left free, by licensing conditions, of using less complex formats and lower capacity, provided that they do not exceed the "reference mode" spectral emission, in term of spectrum mask and output power density (e.g. as in the 16 QAM "reference format" example shown in figure I.3) (see note).

- Preventively agree, with the administration concerned, license fee implication, if any, related to variable payload capacity.

- *Mixed-mode*-mode systems should also respect additional requirements deriving from the dynamic change of modulation order (see clause 4.2.7).

- In *mixed-mode* operation, the RSL thresholds for transitions among different modes of operation are defined as appropriate by manufacturer or operators independently from the BER thresholds defined in clause 4.3.2 for the assessment of article 3.2 of the R&TTED [1].

NOTE: In line with the current provisions for ATPC operation, when actually operating in the reference mode, the output power density, with the agreement of administration, might slightly increase, with respect to the "*reference mode*" due to ATPC operation in overdrive conditions, provided that its relevant spectrum mask is not exceeded (see annexes I.1 and G of EN 302 217-2-1 [i.24]); this would generally happen for a time percentage less than that of the planning availability conditions (e.g. less than 0,01 % of the time).

I.3.3 Impact on article 3.2 "essential" parameters and operating conditions

From the discussion in previous clauses, for being capable of responding to the above mentioned licensing constraints, the introduction of *mixed-mode* (adaptive) systems within the frame of the present document needed a specific set of parameters related to R&TTED [1] article 3.2 "essential requirements".

These requirements may be summarized as follows:

1) As for any multirate/multiformat equipment, in the scope of the present document, *mixed-mode* systems should demonstrate of being capable of respecting all requirements for each of the rate/format offered (i.e. *mixed-mode* systems are tested as *preset-mode* systems). In this way it is ensured that the any selected "reference mode" (equipment class) can be singularly satisfied (see note).

2) A specific set of presettings in term of matching payload capacity, modulation format and transmit power (including RTPC/ATPC operations) is defined and assessed so that, within a licensed constant channel bandwidth and whichever is the instantaneously used mode (format), the TX spectrum mask, will not exceed that of the "*reference-mode*" equipment class, as defined in the present document, among any possibly declared ones (which will be used for the link-by-link frequency coordination/licensing process) (see note).

3) Ensure that requirement 2) above is respected also during dynamic transitions between different modes. A specific requirement and conformance test, has been introduced.

NOTE: According requirement 2, *mixed-mode* systems, when in operation, do not need to meet all spectrum mask requirements in 1, which are tested for R&TTED [1] article 3.2 conformance purpose only; from the technical co-ordination point of view, only that of the "*reference-mode*" equipment class should be respected. Licensing fees, possibly related to system capacity, are not in the scope of the present document, but are responsibility of national administrations.

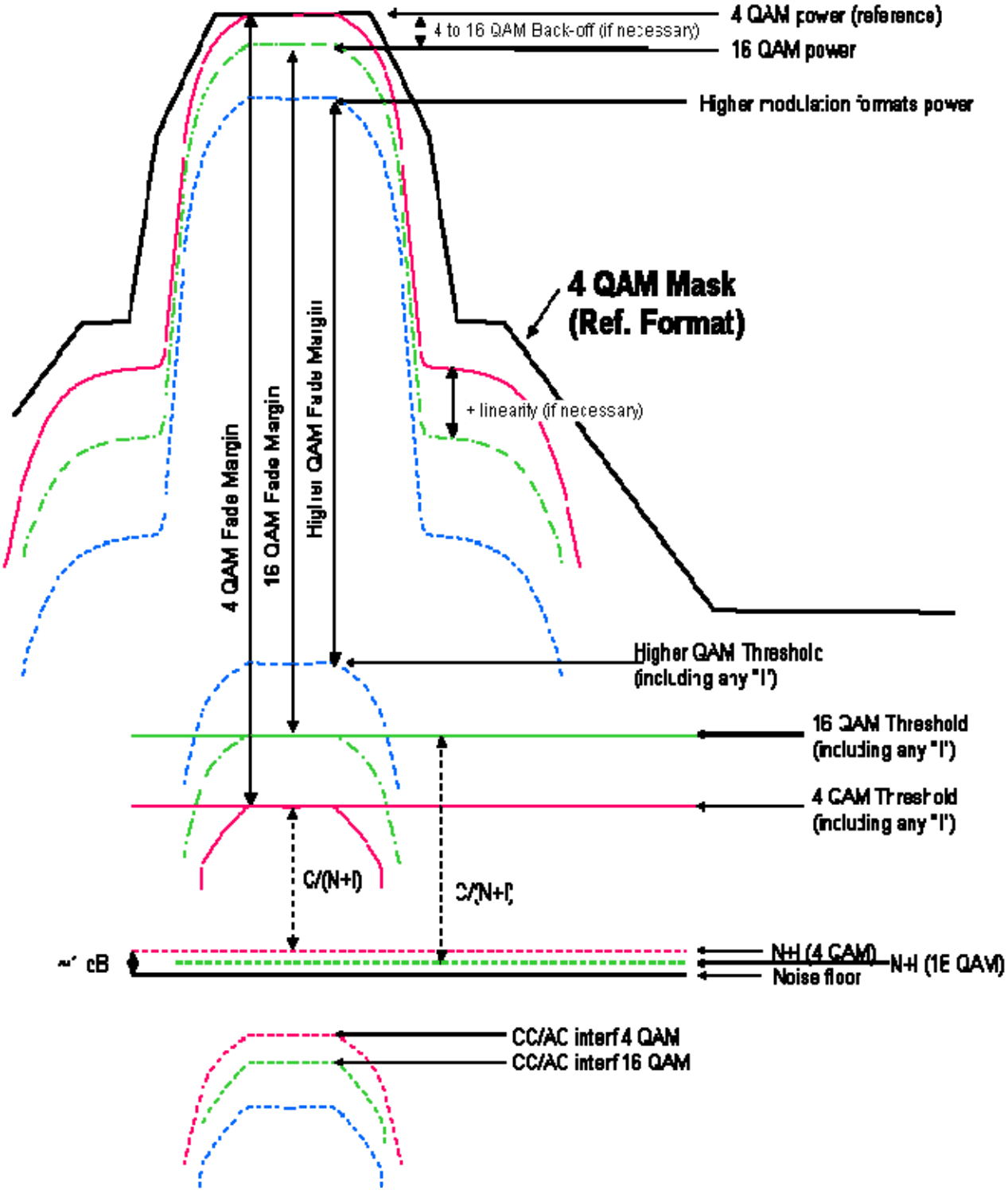


**Figure I.2: Example of reference modulation format 4 QAM:
Delta Fade Margin (dB) = Delta Thr + Back-off**

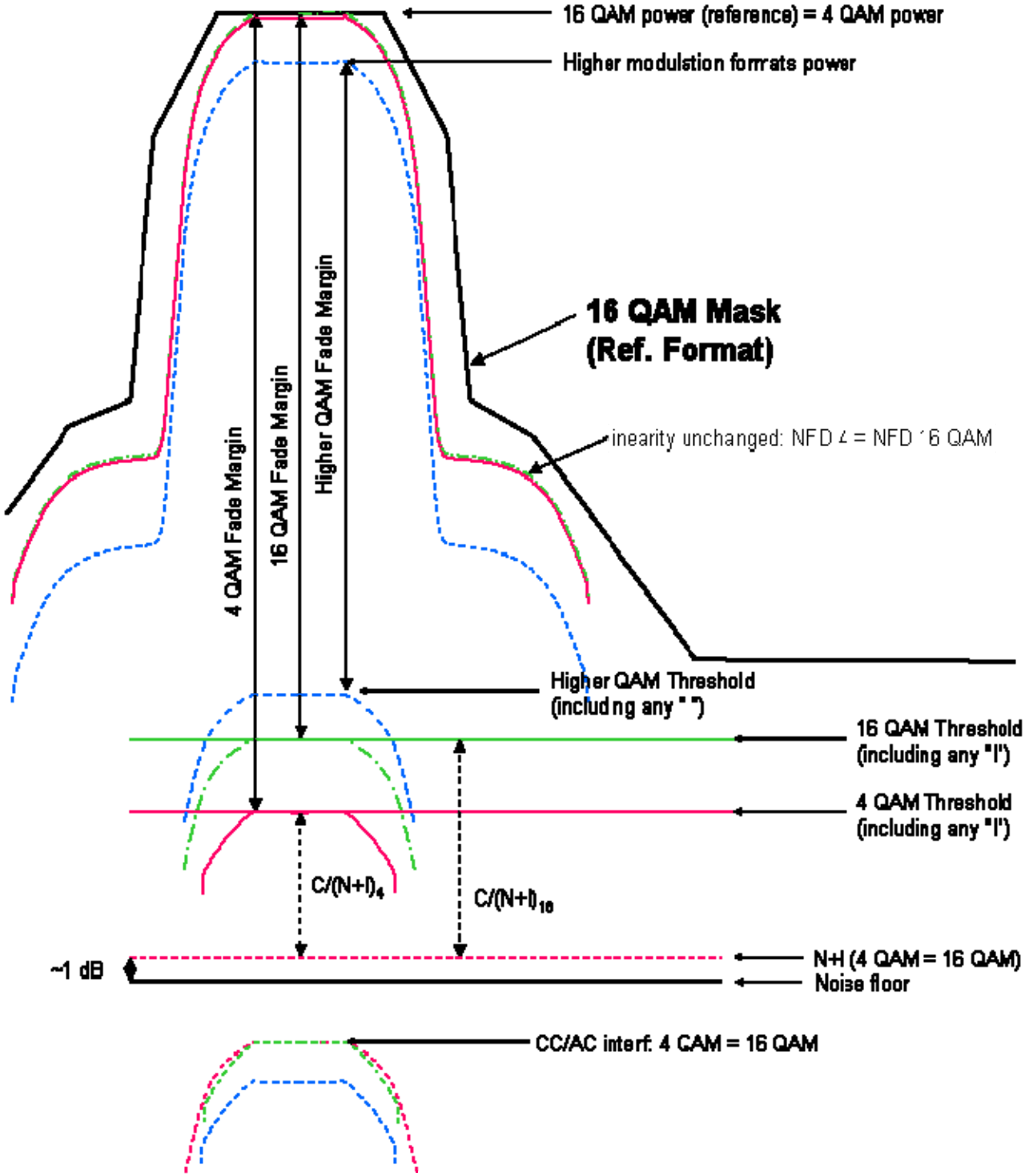


Figure I.3: Example of reference modulation format 16 QAM:
Delta Fade Margin 4/16 = Delta Thr
Delta Fade Margin 16/HigherQAM = Delta Thr+Back-off

Annex J (informative): Typical interference sensitivity behaviour for frequency planning purpose

In annexes B to E, for conformity assessment and declaration, the requirements for co-channel and adjacent channel(s) are limited to discrete guaranteed points at 1 dB and 3 dB degradation of the RSL for BER $\leq 10^{-6}$.

Figure J.1 shows the typical behaviour for intermediate points which can be used for frequency planning purpose. Two different plots are given that are dependant on the difference between 1 dB and 3 dB RSL degradation.

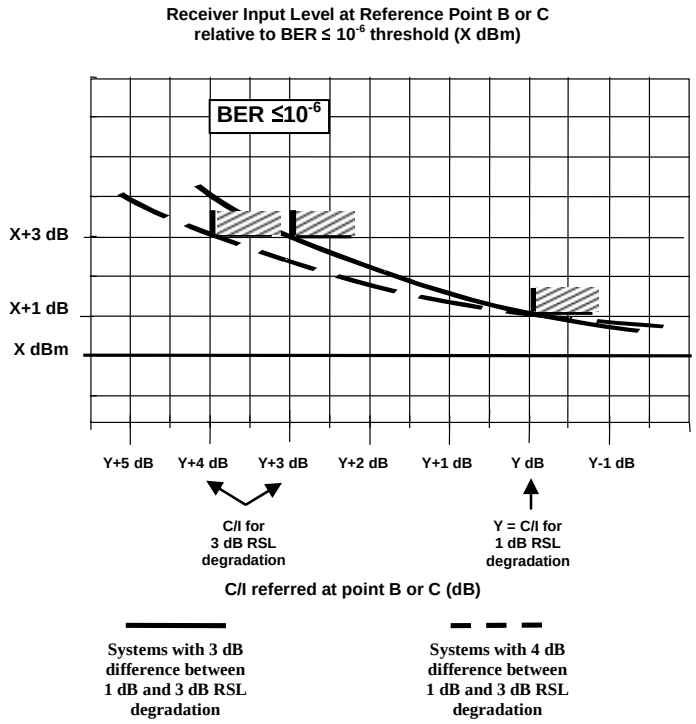


Figure J.1: Interference threshold degradation versus C/I (typical behaviour)

Annex K (informative): The EN title in the official languages

The enlargement of the European Union (EU) resulted in a requirement from the EU for a larger number of languages for the translation of the titles of Harmonized Standards and mandated ENs that are to be listed in the Official Journal to support the implementation of this legislation.

For this reason the title translation concerning the present document can be consulted via the e-approval application.

Annex L (informative): Bibliography

- ERC/DEC(00)07: "ERC Decision of 19 October 2000 on the shared use of the band 17.7 - 19.7 GHz by the fixed service and Earth stations of the fixed-satellite service (space to Earth)".
- 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".
- ETSI EN 302 217-4-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-1: System-dependent requirements for antennas".
- Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

History

Document history		
V1.1.3	December 2004	Publication
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