Final draft ETSI EN 302 217-2-2 V2.1.0 (2013-04)


# 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

Reference
REN/ATTM-04018

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antenna, DFRS, digital, DRRS, FWA,
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# Contents

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# Foreword

This final draft Harmonized European Standard (EN) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM), and is now submitted for the Vote phase of the ETSI standards Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Directive 98/34/EC [i.2] as amended by Directive 98/48/EC [i.64].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [1].

See article 5.1 of Directive 1999/5/EC [1] for information on presumption of conformity and Harmonized Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

The requirements relevant to Directive 1999/5/EC [1] are summarized in annex H.

The present document is part 2, sub-part 2 of a multi-part deliverable covering Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas. 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 |

### Major variants with respect to previous published version

This new version of EN 302 217-2-2 has considered, among other minor points:

- Unified frequency tolerance.
- Unified output power tolerance.
- More flexible specification for spectral lines exceeding the spectral density mask.
- New spectral efficiency classes 7 (1 024 states) and 8 (2 048 states) have been introduced for channel separations 13,75/14 MHz and above.

- Extension of the spectral efficiency classes subdivision to formally cover the whole granularity of the range spectral efficiency indexes provided for each band and channel separation. Indexes from 1 (2 states, spectral efficiency class 1) to 11 (2 048 states, spectral efficiency class 8) and to newly introduced 10 and 11 (1 024 and 2 048 states, spectral efficiency class 7 and 8) are introduced, as appropriate, for filling the gaps between the minimum and maximum indexes foreseen.

- Unified spectrum masks for classes 5, 6, 7 and 8 also for 40 MHz and for 110 MHz/112 MHz channels.

- Use, as system identification method, of the "minimum radio interface capacity (RIC)", more appropriate for new Ethernet oriented systems, in place of the previous PDH/SDH oriented one.

- Removal of the other system identification parameter based on A.1, ….., B.1,….., C.1,….., E.1, …… notations. Unique system identification is based on operating frequency band, operating radio frequency channel separation and spectral efficiency class to which a minimum RIC is associated.

- Tighter BER Receiver Signal Level (RSL) thresholds for a large number of systems; this is justified by recognizing, in previous V1.4.1 of the present document, the very large margins against the required values with respect to current equipment technology on the market and by the need for improving the link density in frequency coordinated networks.

- Significant revision of the informative annex I for guidance in the use and deployment of ATPC and "*mixed-mode*" (adaptive modulation systems).

- Clarification and distinction between "*multi-carrier*" and "*multi-channel*" systems concepts and related requirements.

- New frequency bands from 71 GHz to 76 GHz and 81 GHz to 86 GHz (additional requirements to the general ones in EN 302 217-3 [7] for equipment intended also for conventional link-by-link coordination).

In general, apart from the tightened RSL BER thresholds (see note 1), the requirements for equipment types already covered by previous versions of the present document are carried over unchanged (see notes 2 and 3); therefore, it is considered that equipment already conforming to those previous versions would not need a new test report for re-assessment of the essential requirements according to the present document. However, the legal aspects related to the Declaration of Conformity according the Directive 1999/5/EC [1] are not in the scope of the present document.

NOTE 1: The tightened RSL BER thresholds are still considered to offer a good margin to equipment on the market and also to equipment that is already in operation since several years before the date of publication of the present document.

NOTE 2: Even if considered not impacting modern synthesizer technology, few cases of more stringent frequency tolerance resulted from the unification of the requirement.

NOTE 3: The "minimum RIC" limits have been enhanced from previous V1.4.1 of the present document; however, they are considered well within the present technology capability. It should be noted that the original values, standardized in annex F of previous V1.1.3 of the present document (formally applicable up to May 2009), were already significantly higher than those reported in subsequent versions of the present document. Those "more relaxed" ones, used up to V1.4.1 of the present document as "provisional stop-gap" for early introduction of Ethernet systems among PDH/SDH oriented characteristics, will cease to be applicable after the decaying date from the OJEU of the said V1.4.1.

Attention is also drawn to the fact that older spectral power density masks, some of which have been maintained as equivalent alternative option in the annexes A through E, are supposed, in medium term maintenance process, to be discontinued. Newly assessed equipment is supposed to use the "unified masks" in clause 4.2.4.2.1.

# Introduction

The EN 302 217 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.24].

**Figure 1: Void**

# 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 division full duplex (FDD) in frequency bands, where co-ordinated link-by-link frequency planning is applied. 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.

For the correct understanding and application of the requirements in the present document, the definitions summarized in EN 302 217-1 [6] are also relevant.

## 1.2 Spectral efficiency classes

As the maximum transmission rate in a given bandwidth depends on system spectral efficiency, different equipment classes are here defined. They are based on typical modulation formats and limited by a "minimum Radio Interface Capacity density" (Mbit/s/MHz) shown in table 0. Radio Interface Capacity (RIC) is defined in EN 302 217-1 [6].

The minimum RIC density figures in table 0 are valid only for systems operating on the most common channel separation (CS) equal or higher than 1,75 MHz and taking into account that for channel separations "about" 14 MHz (i.e. from 13,75 MHz to 15,0 MHz), "about" 28 MHz (i.e. from 27,5 MHz to 30 MHz), "about" 56 MHz (i.e. from 55 MHz to 60 MHz) and "about" 112 MHz (i.e. 110 MHz or 112 MHz) the RIC density of actual systems is evaluated only over the "nominal" 14 MHz, 28 MHz, 56 MHz and 112 MHz channel width.

Minimum RIC figures for some systems operating on 40 MHz channel separation, with RIC density lower than the minimum requirement in table 0, are defined only in annexes C and Ea. For the special cases of sub-STM-0 capacities (defined in Recommendation ITU-T G.708 [i.63] in annex D, alternative minimum RIC figures are not defined.

**Table 0: Spectral efficiency classes and their minimum RIC density**

| Reference modulation index | Spectral efficiency class | Minimum RIC density (Mbit/s/MHz) (see note) | Description |
|---|---|---|---|
| 1 | 1 | 0,57 | equipment with spectral efficiency based on typical 2-states modulation scheme (e.g. 2 FSK, 2 PSK) |
| 2 | 2 | 1,14 | equipment with spectral efficiency based on typical 4-states modulation scheme (e.g. 4 FSK, 4QAM) |
| 3 | 3 | 1,7 | equipment with spectral efficiency based on typical 8-states modulation scheme (e.g. 8 PSK) |
| 4 | 4L | 2,28 | equipment with spectral efficiency based on typical 16-states modulation scheme (e.g. 16QAM, 16 APSK) |
| 5 | 4H | 3,5 | equipment with spectral efficiency based on typical 32-states modulation scheme (e.g. 32QAM, 32 APSK) |
| 6 | 5L | 4,2 | equipment with spectral efficiency based on typical 64-states modulation scheme (e.g. 64QAM) |
| 7 | 5H | 4,9 | equipment with spectral efficiency based on typical 128-states modulation scheme (e.g. 128QAM) |
| 8 | 6L | 5,6 | equipment with spectral efficiency based on typical 256-states modulation scheme (e.g. 256QAM) |
| 9 | 6H | 6,3 | equipment with spectral efficiency based on typical 512-states modulation scheme (e.g. 512QAM) |
| 10 | 7 | 7 | equipment with spectral efficiency based on typical 1024-states modulation scheme (e.g. 1024QAM) |
| 11 | 8 | 7,7 | equipment with spectral efficiency based on typical 2048-states modulation scheme (e.g. 2048QAM) |
| NOTE: When defining the minimum RIC for actual channel separations, for simplicity, it will be rounded to the suitably closer integer Mbit/s. | | | |

All classes up to class 4H, for any CS, and classes 5L, 5H, 6L, 6H, 7 and 8, for CS < 27,5 MHz, are intended suitable for ACCP operation and, in principle, whenever appropriate, also expandable to CCDP. Classes 5L, 5H, 6L, 6H, 7 and 8, only for CS ≥ 27,5 MHz, are further subdivided in two sub-classes:

- subClass A: classes 5LA, 5HA, 6LA, 6HA, 7A and 8A are intended suitable, on the same route, for cross-polar adjacent channel (ACAP) operation only (see figure 2a).
- subClass B: classes 5LB, 5HB, 6LB, 6HB, 7B and 8B are suitable, on the same route, for ACCP operation and, in principle, whenever appropriate, also expandable to CCDP (see figure 2a).

The above classes are for system identification only and will not imply any constraint to the actual modulation format, provided that all the requirements of the selected class in the relevant parts of 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 [8], 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; actual equipment may operate within one spectral efficiency class only (*Single-mode*) or within multiple classes, either with static pre-selection of the class (*Preset-mode*) or with dynamic variation of capacity 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 and in TR 103 103 [i.35].

## 1.4 Channel arrangements and utilization

Systems in the scope of the present document are intended to operate only in full frequency division duplex (FDD). Time division duplex (TDD) applications are not in the scope of the present document.

Unidirectional systems are assumed to be an underequipped FDD system.

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 spectral 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 2a.

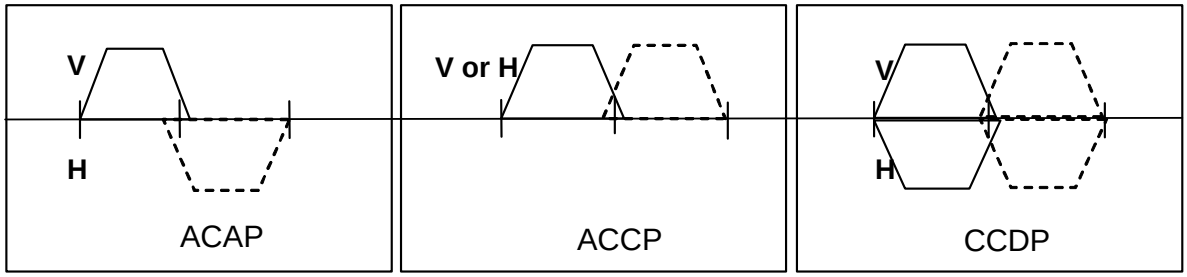



**Figure 2a: Examples of channel arrangements on the same route**

## 1.5 Payload flexibility

For quick identification of the system, the capacities in tables X.2 (where X = A, B, C, D, E, Ea represents the relevant annex) are the minimum transmitted RIC required for conformance to the present document; they are based on the "minimum RIC density" defined in clause 1.2. Only some cases of systems in annex A, due to the smaller channel separation provided, are (exceptionally) labelled with typical *gross bit rate* rather than minimum RIC capacity rates.

However, equipment may offer a variety of base band interfaces, e.g. typical hierarchical rates PDH or SDH, ISDN, Ethernet as well as mixture of these or other standardized interfaces. Mapping/multiplexing of the various base-band interfaces into common frame(s) suitable for radio transmission may be done using standardized higher hierarchical frames or other proprietary methods.

NOTE: Information on applicable base-band interfaces can be found in EN 302 217-1 [6].

Tables F.1a through F.1g in annex F summarize the "minimum RIC" considered in the present document and, when only PDH or SDH interfaces are provided, give the equivalent capacity in term of number of 2,048 Mbit/s streams provided as multiple or single multiplexed PDH or SDH interfaces. These minimum capacities will be associated to the relevant channel separation and spectral efficiency classes defined.

Equipment may operate with one single RIC payload rate or with multiple RIC 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 carrying 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 (see clause G.3). 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 [8] apply. For more background information on the equipment and antenna parameters here identified as relevant to article 3.2 of R&TTE Directive [1] see EG 201 399 [i.24] and TR 101 506 [i.30].

For simplicity, the point-to-point systems refer to a number of technical requirements, common to all bands, which are described in the main body of the present document, while frequency dependent requirements 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 payloads capacity ranging from 0,0096 Mbit/s to 38 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 minimum RIC payload rates ranging from 2 Mbit/s up to about 430 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 for minimum RIC payload rates from about 137 Mbit/s to about 300 Mbit/s or hierarchic from STM-1 to 2 × STM-1 (ACAP or ACCP) and STM-4/4 × STM-1 for CCDP operation or spread over 2 × 40 MHz channels). 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, for 18 GHz band only, up to 110 MHz) for minimum RIC payload rates ranging from 2 Mbit/s up to about 430 Mbit/s and up to 860 Mbit/s in 18 GHz band. See detailed summary in table D.2.

- Annex E: Frequency bands from 23 GHz to 55 GHz:
  #For frequency bands 23 GHz to 42 GHz, systems with channel separations ranging from 3,5 MHz to 112 MHz for minimum RIC payload rates ranging from 2 Mbit/s up to about 860 Mbit/s. See detailed summary in table E.2.
  #For frequency bands 50 GHz to 55 GHz, systems with channel separations ranging from 3,5 MHz to 56 MHz for minimum RIC payload rates ranging from 2 Mbit/s up to about 128 Mbit/s. See detailed summary in table E.2.

- Annex Ea: Frequency bands from 71 GHz to 76 GHz and 81 GHz to 86 GHz:
  Systems with channel separation ranging from 250 MHz to 2 000 MHz for minimum RIC payload rates ranging from about 140 Mbit/s up to about 3 000 Mbit/s. See detailed summary in table Ea.2.

In those annexes further subdivision 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 specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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

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

## 2.1 Normative references

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

[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 (01-2011): "Unwanted emissions in the spurious domain".

[3] ETSI EN 301 126-1 (V1.1.2) (09-1999): "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) (12-2002): "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) (11-2003): "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 (V2.1.0) (04-2013): "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview and system-independent common characteristics".

[7] ETSI EN 302 217-3 (V2.1.0) (04-2013): "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Equipment operating in frequency bands where both frequency coordinated or uncoordinated deployment might be applied; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[8] ETSI EN 302 217-4-2 (V1.5.1) (01-2010): "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4-2: Antennas; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[9] 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".

[10] 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".

[11] ITU Radio Regulations (2008).

[12] Recommendation ITU-T O.151 (10-1992) Corrigendum 1 (05-2002): "Error performance measuring equipment operating at the primary rate and above".

[13] Recommendation ITU-T O.181 (05-2002): "Equipment to assess error performance on STM-N interfaces".

[14] Recommendation ITU-T O.191 (02-2000): "Equipment to measure the cell transfer performance of ATM connections".

## 2.2 Informative references

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

[i.1] Void.

[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 (2010): "Preferred channel arrangement for digital fixed service systems operating in the frequency band 31.8 - 33.4 GHz".

[i.4] CEPT/ERC/REC 12-02 (2007): "Harmonized radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 12.75 GHz to 13.25 GHz".

[i.5] 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.6] CEPT/ERC/REC 12-05 (2007): "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10.0 - 10.68 GHz".

[i.7] CEPT/ERC/REC 12-06 (2010): "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10.7 GHz to 11.7 GHz".

[i.8] 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.9] 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.10] CEPT/ERC/REC 12-10: "Harmonized radio frequency arrangements for digital systems operating in the band 48.5 GHz - 50.2 GHz".

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

[i.12] CEPT/ERC/REC 12-12 (2001): "Radio frequency channel arrangement for fixed service systems operating in the band 55.78-57.0 GHz".

[i.13] CEPT/ERC/REC 14-01 (2007): "Radio-frequency channel arrangements for high capacity analogue and digital radio-relay systems operating in the band 5925 MHz - 6425 MHz".

[i.14] CEPT/ERC/REC 14-02 (2009): "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.15] 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.16] CEPT/ERC/REC T/R 12-01 (2010): "Harmonized radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 37-39.5 GHz".

[i.17] CEPT/ERC/REC T/R 13-01 (2010): "Preferred channel arrangements for fixed services in the range 1-3 GHz".

[i.18] CEPT/ERC/REC T/R 13-02 (2010): "Preferred channel arrangements for fixed services in the range 22.0 - 29.5 GHz".

[i.19] ECC/REC(01)04 (2010): "Recommended guidelines for the accommodation and assignment of Fixed Multimedia Wireless Systems (MWS) and Point-to-point (P-P) Fixed Wireless Systems in the frequency band 40.5-43.5 GHz".

[i.20] ECC/REC(01)05: "List of parameters of digital point-to-point fixed radio links used for national planning".

[i.21] ECC/REC(02)02 (2010): "Channel arrangement for digital fixed service systems (point-to-point and point-to-multipoint) operating in the frequency band 31 - 31.3 GHz".

[i.22] ECC/REC (02)06 (2011): "Preferred channel arrangements for digital fixed service systems operating in the frequency range 7125-8500 MHz".

[i.23] ECC/REC(05)07 (2009): "Radio frequency channel arrangements for fixed service systems operating in the bands 71-76 GHz and 81-86 GHz".

[i.24] ETSI EG 201 399 (V2.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the R&TTE Directive".

[i.25] Void.

[i.26] Void.

[i.27] 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.28] ETSI EN 302 326-2: "Fixed Radio Systems; Multipoint Equipment and Antennas; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive for Digital Multipoint Radio Equipment".

[i.29] ETSI TR 100 028 (all Parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[i.30] 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.31] 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.32] ETSI TR 102 215: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Recommended approach, and possible limits for measurement uncertainty for the measurement of radiated electromagnetic fields above 1 GHz".

[i.33] 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.34] ETSI TR 102 565: "Fixed Radio Systems (FRS); Point-to-point systems; Requirements and bit rates of PtP Fixed Radio Systems with packet data interfaces, effects of flexible system parameters, use of mixed interfaces and implications on IP/ATM networks".

[i.35] ETSI TR 103 103: "Fixed Radio Systems; Point-to-point systems; ATPC, RTPC, Adaptive Modulation (mixed-mode) and Bandwidth Adaptive functionalities; Technical background and impact on deployment, link design and coordination".

[i.36] Recommendation ITU-R F.382-8: "Radio-frequency channel arrangements for fixed wireless systems operating in the 2 and 4 GHz bands".

[i.37] Recommendation ITU-R F.383-8: "Radio-frequency channel arrangements for high capacity fixed wireless systems operating in the lower 6 GHz (5 925 to 6 425 MHz) band".

[i.38] Recommendation ITU-R F.384-11: "Radio-frequency channel arrangements for medium and high capacity digital fixed wireless systems operating in the 6 425-7 125 MHz band".

[i.39] Recommendation ITU-R F.385-10: "Radio-frequency channel arrangements for fixed wireless systems operating in the 7 110-7 900 MHz band".

[i.40] Recommendation ITU-R F.386-8: "Radio-frequency channel arrangements for fixed wireless systems operating in the 8 GHz (7 725 to 8 500 MHz) band".

[i.41] Recommendation ITU-R F.387-12: "Radio-frequency channel arrangements for fixed wireless systems operating in the 10.7-11.7 GHz band".

[i.42] Recommendation ITU-R F.497-7: "Radio-frequency channel arrangements for fixed wireless systems operating in the 13 GHz (12.75-13.25 GHz) frequency band".

[i.43] Recommendation ITU-R F.595-10: "Radio-frequency channel arrangements for fixed wireless systems operating in the 17.7-19.7 GHz band".

[i.44] Recommendation ITU-R F.635-6: "Radio-frequency channel arrangements based on a homogeneous pattern for fixed wireless systems operating in the 4 GHz band".

[i.45] Recommendation ITU-R F.636-4: "Radio-frequency channel arrangements for fixed wireless systems operating in the 14.4-15.35 GHz band".

[i.46] Recommendation ITU-R F.637-4: "Radio-frequency channel arrangements for fixed wireless systems operating in the 21.2-23.6 GHz band".

[i.47] Recommendation ITU-R F.746-10: "Radio-frequency arrangements for fixed service systems".

[i.48] Recommendation ITU-R F.747-1: "Radio-frequency channel arrangements for fixed wireless systems operating in the 10-10.68 GHz band".

[i.49] Recommendation ITU-R F.748-4: "Radio-frequency arrangements for systems of the fixed service operating in the 25, 26 and 28 GHz bands".

[i.50] Recommendation ITU-R F.749-3: "Radio-frequency arrangements for systems of the fixed service operating in sub-bands in the 36-40.5 GHz band".

[i.51] Recommendation ITU-R F.1098-1: "Radio-frequency channel arrangements for fixed wireless systems in the 1 900 - 2 300 MHz band".

[i.52] Recommendation ITU-R 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.53] Recommendation ITU-R F.1191-3: "Necessary and occupied bandwidths and unwanted emissions of digital fixed service systems".

[i.54] Recommendation ITU-R F.1242-0: "Radio-frequency channel arrangements for digital radio systems operating in the range 1 350 MHz to 1 530 MHz".

[i.55] Recommendation ITU-R F.1243-0: "Radio-frequency channel arrangements for digital radio systems operating in the range 2 290-2 670 MHz".

[i.56] Recommendation ITU-R F.1496-1: "Radio-frequency channel arrangements for fixed wireless systems operating in the band 51.4-52.6 GHz".

[i.57] Recommendation ITU-R F.1497-1: "Radio-frequency channel arrangements for fixed wireless systems operating in the band 55.78-59 GHz".

[i.58] Recommendation ITU-R F.1520-3: "Radio-frequency arrangements for systems in the fixed service operating in the band 31.8-33.4 GHz".

[i.59] Recommendation ITU-R F.2005: "Radio-frequency channel and block arrangements for fixed wireless systems operating in the 42 GHz (40.5 to 43.5 GHz) band".

[i.60] Recommendation ITU-R F.2006: "Radio-frequency channel and block arrangements for fixed wireless systems operating in the 71-76 and 81-86 GHz bands".

[i.61] Recommendation ITU-R SM.329-12: "Unwanted emissions in the spurious domain".

[i.62] Recommendation ITU-R SM.1539-1: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329".

[i.63] Recommendation ITU-T G.708 (1999): "Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)".

[i.64] Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

# 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.

In general, terms printed in *Italic characters* are generally defined there.

## 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 are given in EG 201 399 [i.24]; specific applications and descriptions for DFRS are given in TR 101 506 [i.30] and in TR 103 103 [i.35].

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; the latter, for *mixed-mode* and/or *bandwidth-adaptive* systems, is intended as any rate/format defined as *reference-mode*. 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).

## 4.0 System identification and traffic loading

Equipment in the scope of the present document shall refer to a coherent set of transmitter and receiver requirements uniquely defined on the basis of the following identifying parameters:

1) Operating frequency band.

2) Operating radio frequency channel separation.

3) Spectral efficiency class, to which the minimum RIC density, defined in clause 1.2, is associated.

4) Actual declared maximum total RIC transmitted over the channel with the selected spectral efficiency class.

When *mixed-mode* and/or *bandwidth-adaptive* systems are concerned, the identification shall be related only to the *reference-modes*. These can be an arbitrary declared subset of the classes provided in clause 1.2 and, for *bandwidth-adaptive* systems, selected only among those related to the maximum operating bandwidth. Only *reference-modes* shall be considered and are subject to the minimum RIC density limitation of table 0. All other higher or lower complexity or lower bandwidth modes, eventually generated during the dynamic operation of the system, are not subject to that minimum RIC density limitation (see example).

EXAMPLE: A *mixed-mode* system operating with class 4L *reference-mode* (2,28 Mbit/s/MHz minimum RIC) can dynamically operate up to class 7 with a RIC density (e.g. 2,28 Mbit/s × 10/4/MHz = 5,7 Mbit/s/MHz) lower than the minimum RIC (7 Mbit/s/MHz) defined for spectral efficiency class 7. Also, for enhanced availability reasons, the system can drop the modulation format, and/or increase the error correction code redundancy, and/or reduce the operating bandwidth without any constraint in term of related minimum RIC.

It is also recognized that the higher modes (e.g. classes 7 and 8 and, in some cases, also 6H or lower classes) are hardly suitable as *reference-mode* because their very limited fade margin might not be enough to guarantee the required performance and availability objectives in typical links. Therefore they are likely to be used only during dynamic operation with a lower class *reference-mode*. Nevertheless, their systems characteristics are also reported for possible use by special equipment or for reference in administrative licensing procedures.

All the requirements are intended to be met loading the system with the maximum possible RIC, which shall be evaluated and declared by the supplier according the definition in EN 302 217-1 [6] (see note 1). It shall be equal or higher than the minimum RIC defined for the chosen system profile selected from tables A.2, B.2, C.2, D.2, E.2 and Ea.2 (see note 2). However, when the system is carrying only PDH or SDH hierarchical traffic, the minimum declared total RIC capacity shall follow the specific conversion shown in tables F.1a to F.1g in annex F.

NOTE 1: More guidance on the system RIC evaluation can be found in TR 102 565 [i.34].

NOTE 2: Some systems described in table A.2, for CS equal to 2 MHz or for CS lower than 1,75 MHz, do not specify a minimum RIC but only an indicative channel capacity (*gross bit rate*).

When SDH hierarchical capacity higher than STM-1 rate transmission is concerned, the requirements are intended, for applicable systems, with fully loaded STM-4 or 4 × STM-1 or 2 × 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 3: 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.27].

## 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 Recommendation ITU-T O.151 [12] |
| SDH | Recommendation ITU-T O.181 [13] |
| ATM | Recommendation ITU-T O.191 [14] |
| Ethernet interface (packet data) (see note) | IEEE 1802.3 [9] and IEEE 802.3 [10] |
| 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 only in term of "minimum RIC". However, when the BER requirements are considered, they can be directly tested when conventional PDH or SDH interfaces are provided; while, whenever equipment offers different standardized base-band interfaces, annex F gives the criteria for defining an equivalent error rate for conformance purpose. | |

## 4.2.1 Transmitter power and power tolerance

### 4.2.1.1 Maximum power

The maximum power possibly generated by the radio system shall be limited according the relevant provisions given in the Radio Regulations [11], either in term of EIRP of the systems (e.g. in article 21 and, for some specific frequency bands, in footnotes under article 5 of the 2008 edition) (see note) or in term 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.

Only for systems operating in the 71 GHz to 76 GHz and 81 GHz to 86 GHz bands the joint limitation of EIRP, Antenna gain and output power results in maximum output power and output power density, which shall be in agreement with the requirements of annex UC of EN 302 217-3 [7].

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.33] in order to support inter- and intra- compatibility and sharing analysis.

In some frequency bands, or parts of frequency bands, Recommendations ITU-R 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.

### 4.2.1.2 Transmitter power tolerance

The nominal transmitter power shall be declared by the supplier.

Within the environmental profile declared by the supplier for the intended limits of usage of the equipment, the tolerance of the nominal transmitter power shall be contained within the following limits:

- Equipment operating in bands below 3 GHz: +2/-1 dB
- Equipment operating in bands from 3 GHz to 30 GHz: ±2 dB
- Equipment operating in bands higher than 30 GHz: ±3 dB

The test methods and conditions of transmitter power tolerance are specified in clause 5.2.1.

## 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 and TR 103 103 [i.35]. General background for ATPC operation may also be found in annex G of EN 302 217-2-1 [i.27].

#### 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 and TR 103 103 [i.35].

### 4.2.2.2 Remote Frequency Control (RFC)

*Remote Frequency Control* (RFC) 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 Void

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

When "*multi-carrier*" systems are concerned (see definition in EN 302 217-1 [6]) the 0 dB level is relative to the maximum of the modulated spectrum of the sub-carrier with the lowest spectral density, disregarding the level of the possible residual of the carriers (see note ). When applying the spectrum mask, the spectral density of all sub-carriers shall be within 0 dB to $+K_1$ dB of the reference level as shown in the generic example in figure 2b.

NOTE: This is intended for avoid uncertainty due to the unmodulated spectral line that, due to modulation imperfection, might become visible at the carrier (or sub-carriers) centre frequency; its relative level, with respect to the 0 dB reference, variable with the reference bandwidth, is not relevant for the test itself.

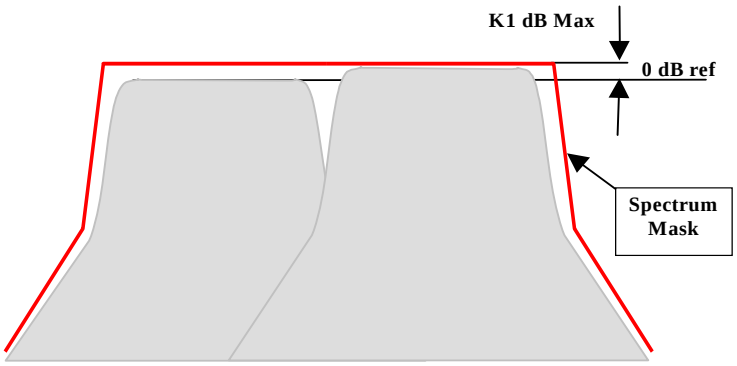
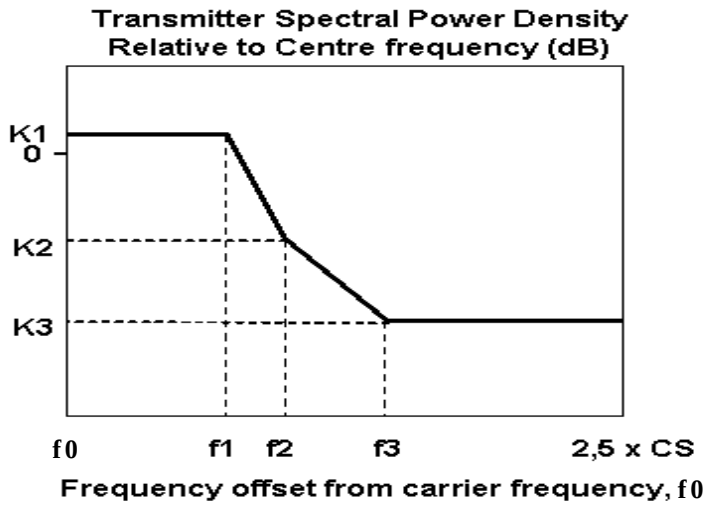



**Figure 2b: Example of 0 dB reference setting for *multi-carrier* equipment**

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 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.

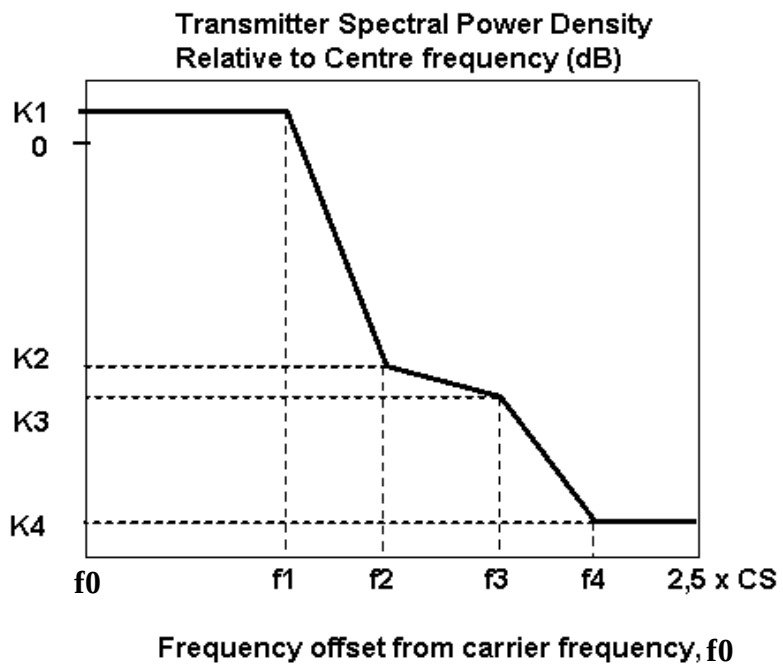
It is also assumed that the value associated with the final discreet point on the graph extends to a point equal to 2,5 times the channel separation (i.e. 2,5 × CS) or, for emissions bandwidth > 500 MHz, to a reduced extension according recommendation Recommendation ITU-R SM.1539-1 [i.62] (i.e. 1,5 × CS + 500 MHz) 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.



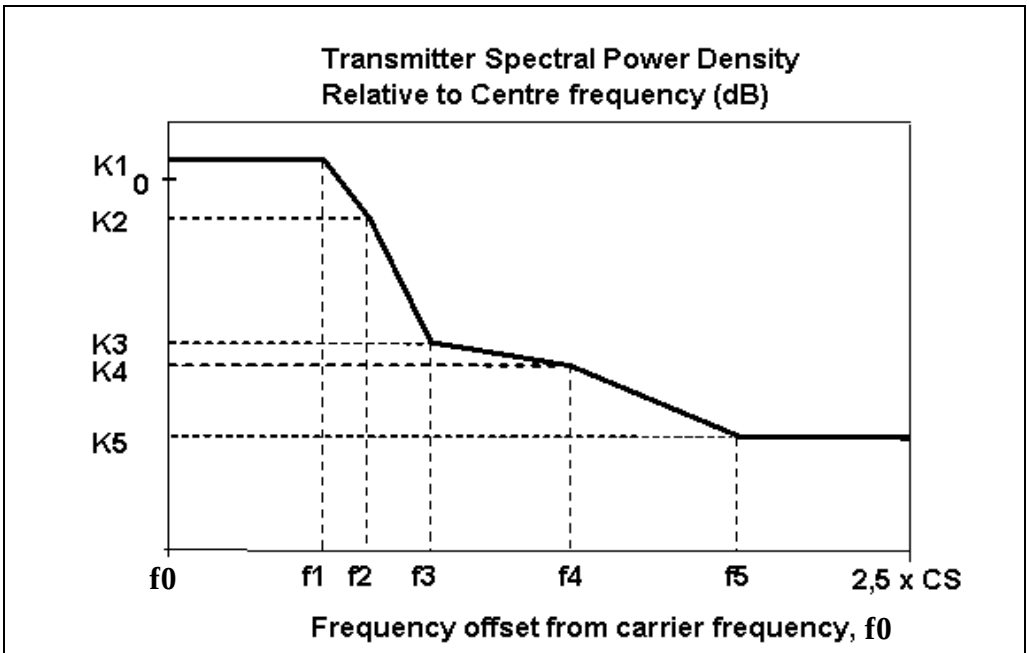

| Number of segments | K1 in dB<br>f1 in MHz | K2 in dB<br>f2 in MHz | K3 in dB<br>f3 in MHz |
|---|---|---|---|
| 4 | K1/f1 | K2/f2 | K3/f3 |

**Figure 3: Four segment spectrum mask**



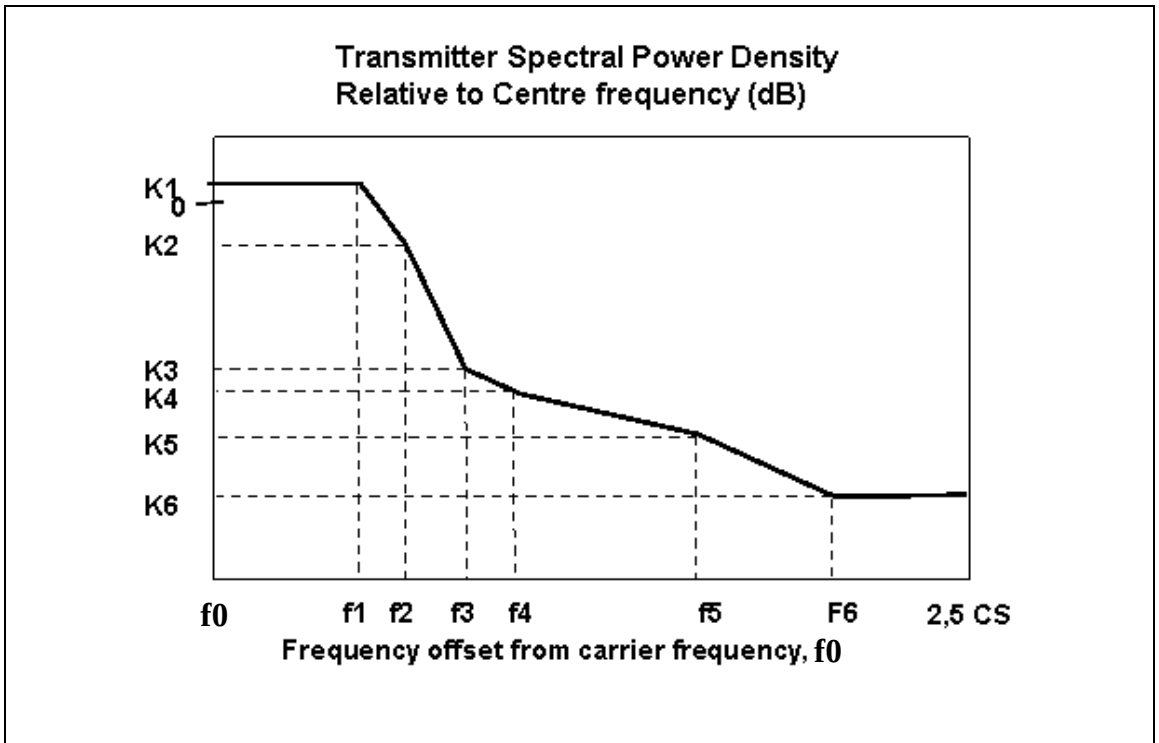

| Number of segments | K1 in dB<br>f1 in MHz | K2 in dB<br>f2 in MHz | K3 in dB<br>f3 in MHz | K4 in dB<br>f4 in MHz |
|---|---|---|---|---|
| 5 | K1/f1 | K2/f2 | K3/f3 | K4/f4 |

**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 spectral emission shall comply with spectral power density of either the "unified" masks or the "alternative and system specific" masks provided in next two clauses 4.2.4.2.1 or 4.2.4.2.2.

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.

For *preset-mode* systems, the manufacturer shall declare which spectral efficiency classes the equipment offers, within each CS. 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 *Reference Modes* can be supported by the equipment, within each CS (see example). For each *Reference Mode* the equipment shall demonstrate the capability of being compliant with the RF spectrum mask associated with the corresponding system parameters and spectral efficiency class (see note). Compliance with the RF spectrum mask can be jointly verified with the "dynamic change of modulation" requirement in clause 4.2.7.

Other modes, not considered, in the manufacturer declaration, valid as *Reference Mode*, may be activated during dynamic operation (see example), but are not subject to any requirement besides being also enabled for the "dynamic change of modulation" requirement in clause 4.2.7.

EXAMPLE: More than one *Reference Mode* may be declared; e.g. for a CS = 28 MHz three *Reference Mode* are declared: Class 2 (e.g. 4QAM, 32 Mbit/s min RIC), Class 4L (e.g. 16QAM, 64 Mbit/s min RIC) and Class 5HB (e.g. 128QAM, 137 Mbit/s min RIC). In this case three relevant set of tests for spectrum mask (and all other relevant parameters) should be provided. The license conditions will reference only to one of the possible *Reference mode* according the operator and/or the national authority needs. When the dynamic operation is enabled, modulation formats, other than the three related to the *Reference Modes*, can be operated, intermediate to them (e.g. 8PSK, 32QAM and 64QAM), higher (e.g. 256QAM, 1024QAM) or lower (e.g. PSK).

NOTE: 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 unique actual *Reference Mode* used for co-ordination purpose; see clause I.2.

Only for equipment in the band 71 GHz to 86 GHz, *mixed-mode* operation may include also *bandwidth-adaptive* operations (see definition in EN 302 217-1 [6]). In this case, the spectrum mask for compliance shall be the one relevant to the maximum CS used by the equipment during dynamic operation, declared by the manufacturer; consequently, the "reduced bandwidth" mode of operation, cannot be used as *Reference Mode*.

##### 4.2.4.2.1 Unified masks

Figure 6a shows the "up to scale" unified set of spectral power density masks for spectral efficiency classes 1, 2, 3, 4L, 4H, 5L, 5H, 6L, 6H, 7, 8, valid for all frequency bands up to 57 GHz.

Figure 6b shows the "up to scale" unified set of spectral power density masks for spectral efficiency classes 1, 2, 3, 4L, 4H, 5L, 5H and 6L, valid for frequency bands 71 GHz to 76 GHz and 81 GHz to 86 GHz.

NOTE 1: Each mask has corner points with constant attenuation while offset frequencies vary with CS.

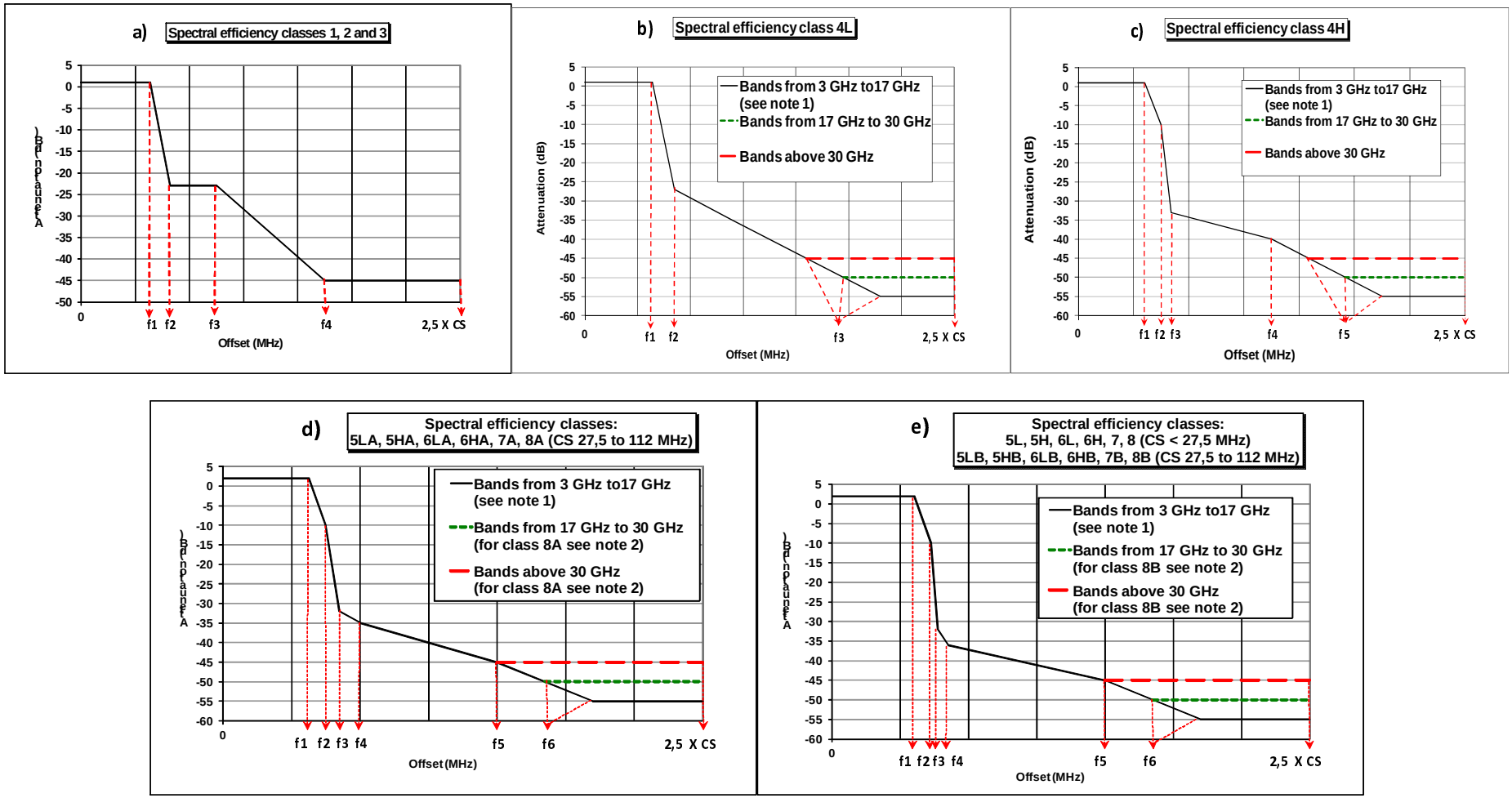
Tables 2a through 2h give all the corner points, graphically shown in figure 6a, for the foreseen channel separations, spectral efficiency classes and minimum RIC capacity for all frequency bands up to 57 GHz.

Table 2k gives all the corner points, graphically shown in figure 6b, for the foreseen channel separations, spectral efficiency classes and minimum RIC capacity for frequency bands 71 GHz to 76 GHz and 81 GHz to 86 GHz.

In principle, these unified masks are valid for each combination of equipment class, nominal capacity, CS and frequency band; however, not all combinations are actually possible and fully defined in the present document. Depending on the channel arrangement and the expected usage, only a subset of combinations is fully defined in each band (see note 2); these subsets are summarized in tables A.2, B.2, C.2, D.2 and E.2 in the relevant annexes.

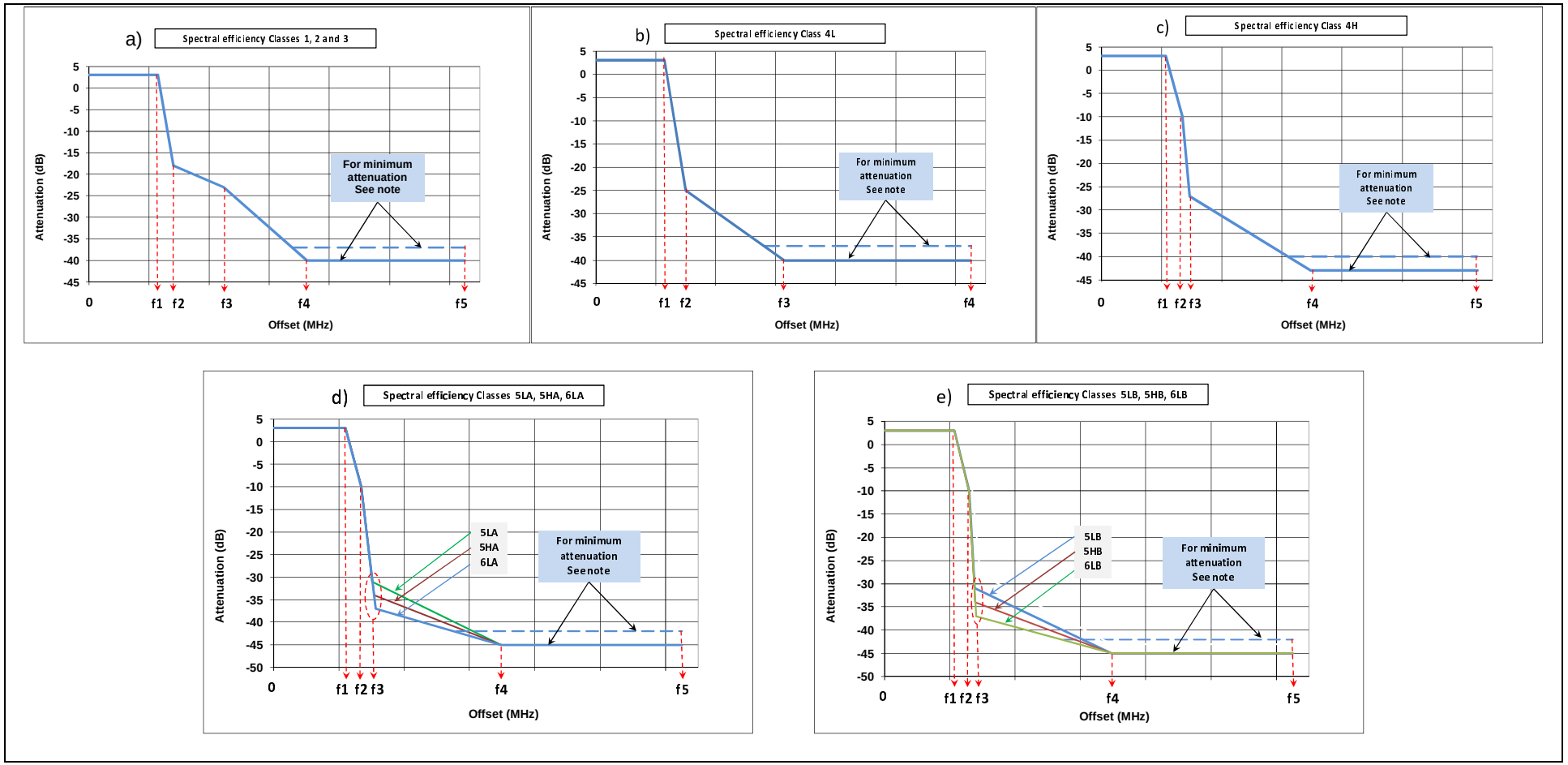
NOTE 2: In particular:

- some class 1 systems are defined only for bands from 1,4 GHz to 2,7 GHz and for 50 GHz and above;
- systems for CS = 1,75 MHz are defined only for classes up to 4L and bands up to 18 GHz;
- systems for CS = 3,5 MHz are not defined for classes higher than 4L and in 42 GHz band;
- classes 6H, 7 and 8 systems are defined only for CS ≥ 13,75 MHz;
- systems for CS = 40 MHz are defined only for classes 5L and higher;
- subdivision of systems into sub-classes A (ACAP) and B (ACCP) are defined only for class 5L and higher classes and for CS ≥ 27,5 MHz.




NOTE 1: See note (1) in tables 2a through 2g.
NOTE 2: For classes 8, 8A and 8B the limit for bands within the range 17 GHz to 30 GHz is valid also above 30 GHz; see notes (2) and (3) in tables 2d through 2f and notes (1) and (2) in table 2g.

**Figure 6a: Unified spectrum masks (frequency bands in the range below 57 GHz)**




NOTE: The noise floor attenuation depends on the CS; see table 2k for details.

**Figure 6b: Unified spectrum masks (frequency bands 71 GHz to 76 GHz and 81 GHz to 86 GHz)**

**Table 2a: Unified spectrum masks: Corner points for CS = 1,75 MHz**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 1 | Figure 6a(a) | 1 | 0,85 | -23 | 1,05 | -23 | 1,7 | -45 | 3 | | | | |
| 2 | 2 | 2 | | | | | | | | | | | | | |
| 3 | 3 | 3 | | | | | | | | | | | | | |
| 4 | 4L | 4 | Figure 6a(b) | 1 | 0,8 | -28 | 1,1 | -55(1)<br>-50(2)<br>-45(3) | 3,5(1)<br>3,1(2)<br>2,6(3) | | | | | | |

(1) For systems in frequency bands within the range from 3 GHz to 17 GHz. In addition, for frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

(2) For systems in frequency bands within the range from 17 GHz to 30 GHz.

(3) For systems in frequency bands in the range above 30 GHz.

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 4 | 4L | 4 | Figure 6a(b) | K3/f3 = -60 dB/4 MHz |

**Table 2b: Unified spectrum masks: Corner points for CS = 3,5 MHz**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 2 | Figure 6a(a) | 1 | 1,7 | -23 | 2,1 | -23 | 3,4 | -45 | 6 | | | | |
| 2 | 2 | 4 | | | | | | | | | | | | | |
| 3 | 3 | 6 | | | | | | | | | | | | | |
| 4 | 4L | 8 | Figure 6a(b) | 1 | 1,6 | -28 | 2,2 | -55(1)<br>-50(2)<br>-45(3) | 7(1)<br>6,2(2)<br>5,2(3) | | | | | | |

(1) For systems in frequency bands within the range from 3 GHz to 17 GHz. In addition, for frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

(2) For systems in frequency bands within the range from 17 GHz to 30 GHz.

(3) For systems in frequency bands in the range above 30 GHz.

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 4 | 4L | 8 | Figure 6a(b) | K3/f3 = -60 dB/8 MHz |

**Table 2c: Unified spectrum masks: Corner points for CS = 7 MHz**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 4 | Figure 6a(a) | 1 | 3,4 | -23 | 4,2 | -23 | 6,8 | -45 | 12 | | | | |
| 2 | 2 | 8 | | | | | | | | | | | | | |
| 3 | 3 | 12 | | | | | | | | | | | | | |
| 4 | 4L | 16 | Figure 6a(b) | 1 | 3,2 | -28 | 4,4 | -55[1]<br>-50[2]<br>-45[3] | 14[1]<br>12,4[2]<br>10,4[3] | | | | | | |
| 5 | 4H | 24 | Figure 6a(c) | 1 | 3 | -10 | 3,75 | -33 | 4,2 | -40 | 8,75 | -55[1]<br>-50[2]<br>-45[3] | 13,75[1]<br>12,075[2]<br>10,425[3] | | |
| 6 | 5L | 29 (ACCP) | Figure 6a(e) | 1 | 3 | -10 | 3,625 | -32 | 3,875 | -36 | 4,25 | -45 | 10 | -55[1]<br>-50[2]<br>-45[3][4] | 13,5[1]<br>11,75[2]<br>10[3][4] |
| 7 | 5H | 34 (ACCP) | | | | | | | | | | | | | |
| 8 | 6L | 39 (ACCP) | | | | | | | | | | | | | |

(1) For systems in frequency bands within the range from 3 GHz to 17 GHz. In addition, for frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

(2) For systems in frequency bands within the range from 17 GHz to 30 GHz.

(3) For systems in frequency bands in the range above 30 GHz.

(4) For systems in frequency bands in the range above 30 GHz; corner points 5 and 6 are coincident.

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 4 | 4L | 16 | Figure 6a(b) | K3/f3 = -60 dB/16 MHz |
| 5 | 4H | 24 | Figure 6a(c) | K5/f5 = -60 dB/15,425 MHz |
| 6, 7, 8 | 5L, 5H, 6L | 29, 34, and 39 (all ACCP) | Figure 6a(e) | K6/f6 = -60 dB/15,25 MHz |

**Table 2d: Unified spectrum masks: Corner points for CS = 13,75 MHz ≤ CS ≤ 15 MHz (Nominal 14 MHz)**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 8 | Figure 6a(a) | 1 | 6,8 | -23 | 8,4 | -23 | 13,6 | -45 | 24 | | | | |
| 2 | 2 | 16 | | | | | | | | | | | | | |
| 3 | 3 | 24 | | | | | | | | | | | | | |
| 4 | 4L | 32 | Figure 6a(b) | 1 | 6,4 | -28 | 8,8 | -55[1]<br>-50[2]<br>-45[3] | 28[1]<br>24,8[2]<br>20,8[3] | | | | | | |
| 5 | 4H | 49 | Figure 6a(c) | 1 | 6 | -10 | 7,5 | -33 | 8,4 | -40 | 17,5 | -55[1]<br>-50[2]<br>-45[3] | 27,5[1]<br>24,15[2]<br>20,85[3] | | |
| 6 | 5L | 58 (ACCP) | Figure 6a(e) | 1 | 6 | -10 | 7,25 | -32 | 7,75 | -36 | 8,5 | -45 | 20 | -55[1]<br>-50[2]<br>-45[3][4] | 27[1]<br>23,5[2]<br>20[3][4] |
| 7 | 5H | 68 (ACCP) | | | | | | | | | | | | | |
| 8 | 6L | 78 (ACCP) | | | | | | | | | | | | | |
| 9 | 6H | 88 (ACCP) | | | | | | | | | | | | | |
| 10 | 7 | 98 (ACCP) | | | | | | | | | | | | | |
| 11 | 8 | 107 (ACCP) | | | | | | | | | | | | | |

(1) For systems in frequency bands within the range from 3 GHz to 17 GHz. In addition, for frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

(2) For systems in frequency bands within the range from 17 GHz to 30 GHz and for class 8B from 17 GHz to 43,5 GHz.

(3) For all but class 8B systems in frequency bands in the range above 30 GHz.

(4) For all but class 8B systems in frequency bands in the range above 30 GHz; corner points 5 and 6 are coincident.

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 4 | 4L | 32 | Figure 6a(b) | K3/f3 = -60 dB/32 MHz |
| 5 | 4H | 49 | Figure 6a(c) | K5/f5 = -60 dB/30,85 MHz |
| 6, 7, 8, 9, 10, 11 | 5L 5H, 6L, 6H, 7, 8 | 58, 68, 78, 88, 98 and 107 (all ACCP) | Figure 6a(e) | K6/f6 = -60 dB/30,5 MHz |

**Table 2e: Unified spectrum masks: Corner points for CS = 27,5 MHz ≤ CS ≤ 30 MHz (Nominal 28 MHz)**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 16 | Figure 6a(a) | 2 | 12,8 | -23 | 16,4 | -23 | 25 | -45 | 45 | | | | |
| 2 | 2 | 32 | | | | | | | | | | | | | |
| 3 | 3 | 48 | | | | | | | | | | | | | |
| 4 | 4L | 64 | Figure 6a(b) | 2 | 12,8 | -27 | 17 | -55[1]<br>-50[2]<br>-45[3] | 56[1]<br>49[2]<br>42[3] | | | | | | |
| 5 | 4H | 98 | Figure 6a(c) | 2 | 12 | -10 | 15 | -33 | 16,8 | -40 | 35 | -55[1]<br>-50[2]<br>-45[3] | 55[1]<br>48,3[2]<br>41,7[3] | | |
| 6 | 5LA | 117 (ACAP) | Figure 6a(d) | 2 | 12,5 | -10 | 15 | -32 | 17 | -35 | 20 | -45 | 40 | -55[1]<br>-50[2]<br>-45[3][4] | 54[1]<br>47[2]<br>40[3][4] |
| 7 | 5HA | 137 (ACAP) | | | | | | | | | | | | | |
| 8 | 6LA | 156 (ACAP) | | | | | | | | | | | | | |
| 9 | 6HA | 176 (ACAP) | | | | | | | | | | | | | |
| 10 | 7A | 196 (ACAP) | | | | | | | | | | | | | |
| 11 | 8A | 215 (ACAP) | | | | | | | | | | | | | |
| 6 | 5LB | 117 (ACCP) | Figure 6a(e) | 2 | 12 | -10 | 14,5 | -32 | 15,5 | -36 | 17 | -45 | 40 | | |
| 7 | 5HB | 137 (ACCP) | | | | | | | | | | | | | |
| 8 | 6LB | 156 (ACCP) | | | | | | | | | | | | | |
| 9 | 6HB | 176 (ACCP) | | | | | | | | | | | | | |
| 10 | 7B | 196 (ACCP) | | | | | | | | | | | | | |
| 11 | 8B | 215 (ACCP) | | | | | | | | | | | | | |

(1) For systems in frequency bands within the range from 3 GHz to 17 GHz. In addition, for frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

(2) For systems in frequency bands within the range from 17 GHz to 30 GHz and for classes 8A and 8B from 17 GHz to 43,5 GHz.

(3) For all but classes 8A and 8B systems in frequency bands in the range above 30 GHz.

(4) For all but classes 8A and 8B systems in frequency bands in the range above 30 GHz; corner points 5 and 6 are coincident.

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 4 | 4L | 64 | Figure 6a(b) | K3/f3 = -60 dB/63 MHz |
| 5 | 4H | 98 | Figure 6a(c) | K5/f5 = -60 dB/61,7 MHz |
| 6, 7, 8, 9, 10, 11 | 5LA, 5HA, 6LA, 6HA, 7A, 8A | 117, 137, 156, 176, 196, 215 (all ACAP) | Figure 6a(d) | K6/f6 = -60 dB/61 MHz |
| 6, 7, 8, 9, 10, 11 | 5LB, 5HB, 6LB 6HB, 7B, 8B | 117, 137, 156, 176, 196, 215 (all ACCP) | Figure 6a(e) | K6/f6 = -60 dB/61 MHz |

**Table 2f: Unified spectrum masks: Corner points for CS = 55 MHz ≤ CS ≤ 60 MHz (Nominal 56 MHz)**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 32 | Figure 6a(a) | 2 | 25,6 | -23 | 32,8 | -23 | 50 | -45 | 90 | | | | |
| 2 | 2 | 64 | | | | | | | | | | | | | |
| 3 | 3 | 96 | | | | | | | | | | | | | |
| 4 | 4L | 128 | Figure 6a(b) | 2 | 25,6 | -27 | 34 | -55[1]<br>-50[2]<br>-45[3] | 112[1]<br>98[2]<br>84[3] | | | | | | |
| 5 | 4H | 196 | Figure 6a(c) | 2 | 24 | -10 | 30 | -33 | 33,6 | -40 | 70 | -55[1]<br>-50[2]<br>-45[3] | 110[1]<br>96,6[2]<br>83,4[3] | | |
| 6 | 5LA | 235 (ACAP) | Figure 6a(d) | 2 | 25 | -10 | 30 | -32 | 34 | -35 | 40 | -45 | 80 | -55[1]<br>-50[2]<br>-45[3][4] | 108[1]<br>94[2]<br>80[3][4] |
| 7 | 5HA | 274 (ACAP) | | | | | | | | | | | | | |
| 8 | 6LA | 313 (ACAP) | | | | | | | | | | | | | |
| 9 | 6HA | 352 (ACAP) | | | | | | | | | | | | | |
| 10 | 7A | 392 (ACAP) | | | | | | | | | | | | | |
| 11 | 8A | 431 (ACAP) | | | | | | | | | | | | | |
| 6 | 5LB | 235 (ACCP) | Figure 6a(e) | 2 | 24 | -10 | 29 | -32 | 31 | -36 | 34 | -45 | 80 | | |
| 7 | 5HB | 274 (ACCP) | | | | | | | | | | | | | |
| 8 | 6LB | 313 (ACCP) | | | | | | | | | | | | | |
| 9 | 6HB | 352 (ACCP) | | | | | | | | | | | | | |
| 10 | 7B | 392 (ACCP) | | | | | | | | | | | | | |
| 11 | 8B | 431 (ACCP) | | | | | | | | | | | | | |

(1) For systems in frequency bands within the range from 3 GHz to 17 GHz. In addition, for frequency bands below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

(2) For systems in frequency bands within the range from 17 GHz to 30 GHz and for classes 8A and 8B from 17 GHz to 43,5 GHz.

(3) For all but classes 8A and 8B systems in frequency bands in the range above 30 GHz.

(4) For all but classes 8A and 8B systems in frequency bands in the range above 30 GHz; corner points 5 and 6 are coincident.

| Spectral efficiency class | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 4 | 4L | 128 | Figure 6a(b) | K3/f3 = -60 dB/126,0 MHz |
| 5 | 4H | 196 | Figure 6a(c) | K5/f5 = -60 dB/123,4 MHz |
| 6, 7, 8, 9, 10, 11 | 5LA, 5HA, 6LA, 6HA, 7A, 8A | 235, 274, 313, 352, 392 431 (all ACAP) | Figure 6a(d) | K6/f6 = -60 dB/122 MHz |
| 6, 7, 8, 9, 10, 11 | 5LB, 5HB, 6LB, 6HB, 7B, 8B | 235, 274, 313, 352, 392 431 (all ACCP) | Figure 6a(e) | K6/f6 = -60 dB/122 MHz |

**Table 2g: Unified spectrum masks: Corner points for CS = 110 MHz to 112 MHz (Nominal 112 MHz) (for bands from 18 GHz up to 42 GHz)**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 1 | 1 | 64 | Figure 6a(a) | 2 | 51,2 | -23 | 65,6 | -23 | 100 | -45 | 180 | | | | |
| 2 | 2 | 128 | | | | | | | | | | | | | |
| 3 | 3 | 191 | | | | | | | | | | | | | |
| 4 | 4L | 256 | Figure 6a(b) | 2 | 51,2 | -27 | 68 | -50[1]<br>-45[2] | 196[1]<br>168[2] | | | | | | |
| 5 | 4H | 392 | Figure 6a(c) | 2 | 48 | -10 | 60 | -33 | 67,2 | -40 | 140 | -50[1]<br>-45[2] | 193,2[1]<br>166,8[2] | | |
| 6 | 5LA | 470 (ACAP) | Figure 6a(d) | 2 | 50 | -10 | 60 | -32 | 68 | -35 | 80 | -45 | 160 | -50[1]<br>-45[2][3] | 188[1]<br>160[2][3] |
| 7 | 5HA | 548 (ACAP) | | | | | | | | | | | | | |
| 8 | 6LA | 627 (ACAP) | | | | | | | | | | | | | |
| 9 | 6HA | 705 (ACAP) | | | | | | | | | | | | | |
| 10 | 7A | 784 (ACAP) | | | | | | | | | | | | | |
| 11 | 8A | 862 (ACAP) | | | | | | | | | | | | | |
| 6 | 5LB | 470 (ACCP) | Figure 6a(e) | 2 | 48 | -10 | 58 | -32 | 62 | -36 | 68 | -45 | 160 | | |
| 7 | 5HB | 584 (ACCP) | | | | | | | | | | | | | |
| 8 | 6LB | 627 (ACCP) | | | | | | | | | | | | | |
| 9 | 6HB | 705 (ACCP) | | | | | | | | | | | | | |
| 10 | 7B | 784 (ACCP) | | | | | | | | | | | | | |
| 11 | 8B | 862 (ACCP) | | | | | | | | | | | | | |

(1) For systems in frequency bands within the range from 17 GHz to 30 GHz and for classes 8A and 8B from 17 GHz to 43,5 GHz.
(2) For all but classes 8A and 8B systems in frequency bands in the range above 30 GHz.
(3) For all but classes 8A and 8B systems in frequency bands in the range above 30 GHz; corner points 5 and 6 are coincident.

**Table 2h: Unified spectrum masks: Corner points for CS = 40 MHz**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | | | |
| 6 | 5LA | 168 (ACAP) | Figure 6a(d) | 2 | 18 | -10 | 21,5 | -32 | 24,5 | -35 | 29 | -45 | 57 | -55(1) | 77(1) |
| 7 | 5HA | 196 (ACAP) | | | | | | | | | | | | | |
| 8 | 6LA | 224 (ACAP) | | | | | | | | | | | | | |
| 9 | 6HA | 252 (ACAP) | | | | | | | | | | | | | |
| 10 | 7A | 280 (ACAP) | | | | | | | | | | | | | |
| 11 | 8A | 308 (ACAP) | | | | | | | | | | | | | |
| 6 | 5LB | 168 (ACCP) | Figure 6a(e) | 2 | 17,2 | -10 | 20,8 | -32 | 22,2, | -36 | 24,5 | -45 | 57 | | |
| 7 | 5HB | 196 (ACCP) | | | | | | | | | | | | | |
| 8 | 6LB | 224 (ACCP) | | | | | | | | | | | | | |
| 9 | 6HB | 252 (ACCP) | | | | | | | | | | | | | |
| 10 | 7B | 280 (ACCP) | | | | | | | | | | | | | |
| 11 | 8B | 308 (ACCP) | | | | | | | | | | | | | |

(1) In addition, for frequency bands in the range below 10 GHz, a second equipment option with spectrum masks floor extended at -60 dB is also here below provided; this frequency corner of the mask shall be derived by linear interpolation from the values in the table. For clarity these values, affecting this corner point, are reported below in this table. 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.

NOTE: Frequency bands with 40 MHz CS are generally intended for high capacity connections. Classes lower than 5L are not considered in the present document.

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | Frequency corner variation for the -60 dB floor option |
|---|---|---|---|---|
| Reference Index | Class | | | |
| 6, 7, 8, 9, 10, 11 | 5LA, 5HA, 6LA, 6HA, 7A, 8A | 168, 196, 224, 252, 280, 308 (ACAP) | Figure 6a(d) | K6/f6 = -60 dB/87 MHz |
| 6, 7, 8, 9, 10, 11 | 5LB, 5HB, 6LB, 6HB, 7B, 8B | 168, 196, 224, 252, 280, 308 (ACCP) | Figure 6a(e) | K6/f6 = -60 dB/87 MHz |

**Tables 2i and 2j: Void**

**Table 2k: Unified spectrum masks: Corner points for CS = N × 250 MHz (see note 1)**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Mask reference shape | K1 (dB) | f1 (MHz) | K2 (dB) | f2 (MHz) | K3 (dB) | f3 (MHz) | K4 (dB) | f4 (MHz) | K5 (dB) | f5 (MHz) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | | | | | | | | | | |
| 1 | 1 | N × 142 | Figure 6b(a) | 3 | N × 114,5 | -18 | N × 140 | -23 | N × 224 | -40 (2) | N × 362,5 | -40 (2) | (1) |
| 2 | 2 | N × 285 (7) | | | | | | | | | | | |
| 3 | 3 | N × 425 (7) | | | | | | | | | | | |
| 4 | 4L | N × 570 (7) | Figure 6b(b) | 3 | N × 114,5 | -25 | N × 149 | -40 (2) | N × 314 | -40 (2) | (1) | | |
| 5 | 4H | N x 875 | Figure 6b(c) | 3 | N × 110 | -10 | N × 134 | -28 | N × 149 | -43 (3) | N × 348 | -43 (3) | (1) |
| 6 | 5LA | N x 1050 (7) | Figure 6b(d) | 3 | N × 110 | -10 | N × 134 | -31 | N × 151 | -45 (4) | N × 348 | -45 (4) | (1) |
| 7 | 5HA | N x 1225 | | | | | | -34 | N × 154 | -45 (5) | | -45 (5) | |
| 8 | 6LA | N x 1400 | | | | | | -37 | N × 156 | -45 (6) | | -45 (6) | |
| 6 | 5LB | N x 1050 (7) | Figure 6b(e) | 3 | N × 107 | -10 | N × 129,5 | -31 | N × 138 | -45 (4) | N × 348 | -45 (4) | (1) |
| 7 | 5HB | N x 1225 | | | | | | -34 | N × 139 | -45 (5) | | -45 (5) | |
| 8 | 6LB | N x 1400 | | | | | | -37 | N × 140 | -45 (6) | | -45 (6) | |

(1) For CS ≤ 500 MHz this value is CS × 2,5.
For CS > 500 MHz, this value is variable with CS (MHz) according the formula CS × 1,5 + 500
(2) Attenuation less than -40 + 10log(N) is not required.
(3) Attenuation less than -43 + 10log(N) is not required.
(4) For N ≥ 2, attenuation less than -46 + 10log(N) is not required.
(5) For N ≥ 3, attenuation less than -49 + 10log(N) is not required.
(6) For N ≥ 6, attenuation less than -52 + 10log(N) is not required.
(7) For class 2 (N=4), class 3 (N=5), class 4 (N=2 and N=4), classes 5LA and 5LB (N=1, 2, 3) a minimum RIC rounded down to closest multiple of 1 Gbit/s rate shall also be considered valid. See table Ea.2 in annex Ea for details.
NOTE 1: N can vary from 1 to 8; however, equipment characteristics are not presented for all cases. See table Ea.2 in annex Ea for details.
NOTE 2: The 10log(N) value is intended truncated to the first decimal place.

#### 4.2.4.2.2 Other alternative and system specific masks options

For some specific cases, if any, other optional masks are reported in the tables of the relevant annexes for the bands concerned.

NOTE 1: Taking into account the large commonality in the design of software programmable DFRS, the unified masks presented in clause 4.2.4.2.1 has been produced through a later stage action of overall rationalization and unification among the various bands, channel separation and spectral efficiency classes. However, in the past, systems were also designed according more band-specific situation and standardized in different times resulting in slightly different masks shapes; they are still considered in this clause 4.2.4.2.2 as equivalent to the "unified" above; this clause also maintains very special cases of CS (e.g. 20 MHz) or spectral classes (e.g. class 1 standardized only in few cases of bands and/or CS). Future maintenance process might further reduce the amount of these optional masks.

NOTE 2: In previous superseded ENs, historically dealing with the same systems (see cross-reference in annex C of EN 302 217-1 [6]), there were masks with more stringent noise floor in relation to intra-system or local antenna system sharing compatibility requirements. The portion of mask exceeding the minimum requirement in clause 4.2.4.2.1 or those in annexes A through E, has not been considered relevant to article 3.2 of R&TTE Directive [1] and is maintained, when their application is appropriate, only as "additional ETSI voluntary characteristic" in EN 302 217-2-1 [i.27].

## 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 carrier (sub-carriers) centre frequency equal to the symbol rate shall be below the mean power level of the carrier by more than:

- 23 dB for classes 0, 1, 2
- 29 dB for class 3
- 37 dB for classes 4L, 4H, 5LA, 5HA, 6LA, 6HA, 7A, 8A
- 43 dB for classes 5L, 5LB, 5H, 5HB
- 49 dB for classes 6L, 6LB, 6H, 6HB
- 55 dB for classes 7, 7B, 8, 8B

### 4.2.5.2 Other discrete CW components exceeding the spectrum mask limit

Should CW components, other than the residual of the unmodulated carrier (sub-carriers), exceed the spectrum mask given in the relevant annexes, an additional allowance is given.

Let CSmin (MHz) be a parameter, dependent on the frequency band and the system under consideration defined in table 3 and the result of the formula:

$$10\log\frac{CS\min}{IFbandwidth}-10 \quad \text{(dB)}$$

be calculated, where IF bandwidth is the recommended resolution bandwidth set out in table 6.

If the result is $\leq 0$ dB, no additional allowance is then permitted.

If the result is > 0 dB the power aggregation of the lines falling, outside the operating CS, within any CSmin width where the spectrum mask is defined shall not exceed the ratio in dB calculated by the following formula:

$$10\log\sum_{i=1}^{i=n}10^{\frac{X_i}{10}} \leq 10\log\frac{CS\min}{IFbandwidth}-10$$

Where $X_i$ is the mask excess (in dB) of the $i^{th}$ of $n$ lines, falling in the CSmin width (see example and figure 7).

EXAMPLE: Figure 7 example applied to the 71 GHz to 86 GHz band (CSmin = 250 MHz; IFbw = 2 MHz) shows that the same effect can be obtained by:

a) one single line, e.g. in leftmost CSmin slot, exceeding the mask by up to 11 dB;
b) two lines (n = 2), e.g. in next CSmin slot, exceeding the mask e.g. up to $X_1$ = 8 dB and $X_2$ = 6,5 dB, respectively;
c) three lines (n = 3), e.g. in rightmost CSmin width, exceeding the mask e.g. up to $X_1$ = 9 dB, $X_2$ = 4,7 dB and $X_3$ = 2 dB, respectively.

**Table 3: CSmin values for relevant bands**

| Frequency band/Channel separation | CSmin (MHz) |
|---|---|
| 1,4 GHz/All channel separations | 0,025 |
| 2,4 GHz/All channel separations | 0,5 |
| 3,4 GHz to 3,8 GHz/Channel separations ≤ 14 MHz | 0,5 |
| 3,6 GHz to 4,2 GHz/Channel separations > 14 MHz | 10 |
| U4 GHz/All channel separations | 10 |
| L6 GHz/All channel separations | 14,825 |
| U6 GHz/All channel separations | 10 |
| 7 GHz and 8 GHz/All channel separations | 7 |
| 10 GHz/All channel separations | 1,5 |
| 11 GHz/All channel separations | 10 |
| 13 GHz, 15 GHz and 18 GHz/All channel separations | 1,75 |
| 23 GHz to 55 GHz (42 GHz excluded)/All channel separations | 3,5 |
| 42 GHz/All channel separations | 7 |
| 71 GHz to 86 GHz | 250 |

Figure 7 shows a typical example of this requirement.

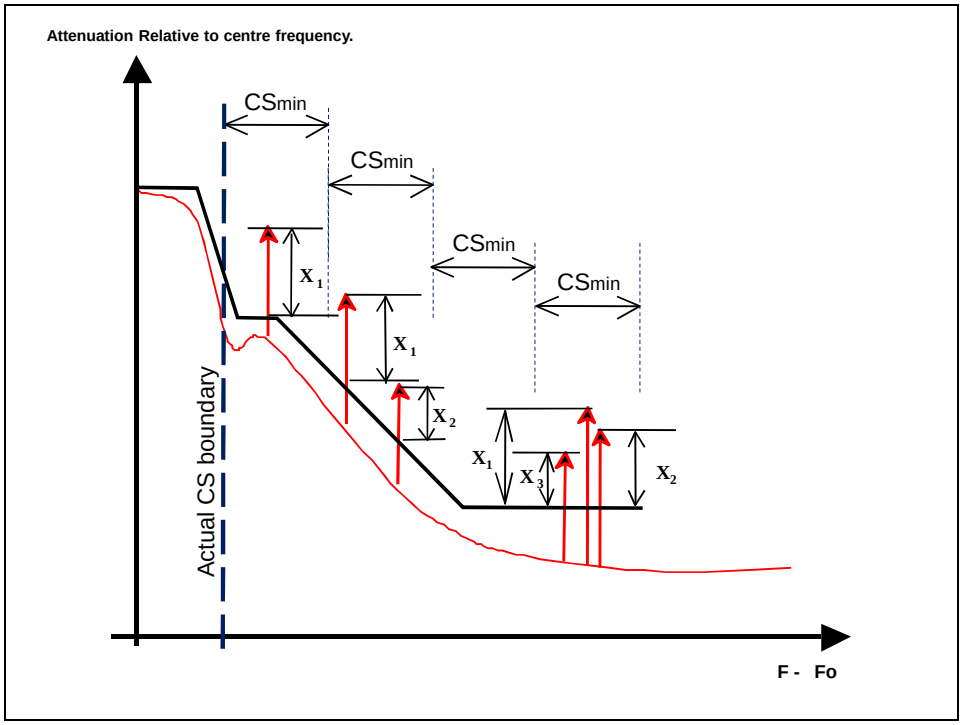



**Figure 7: CW lines exceeding the spectrum mask (typical example)**

## 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 Recommendations ITU-R SM.329-12 [i.61] and Recommendation ITU-R F.1191-3 [i.53] 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 (including *bandwidth adaptive* operation, if any), the transient behaviour of the transmitter, when a transition from any dynamically activated modulation format (and/or any *bandwidth adaptive* operation), to any other occurs, shall meet the specification of the declared *Reference mode* (i.e. reference spectral efficiency class and, when *bandwidth adaptive* system are concerned, widest operating bandwidth) applicable for each relevant CS for:

- the spectral power density mask (see clause 4.2.4.2) with the flat in-band level (i.e. the "K1" mask values) raised to + 3 dB for all systems;
- its associated CW spectral lines allowance (see clause 4.2.5).

In this case, the 0 dB reference of the spectral power density mask, shall be kept fixed as the one obtained with the *Reference mode* in static conditions, except for the case of *bandwidth adaptive* modulation in which the 0 dB reference level can be exceeded by a factor of 10log(BWmax/BWmin), but not more than 6 dB (i.e. 4 times band reduction).

The supplier shall declare, for each CS, among the number of possible equipment operational modes, the possible *Reference mode(s)* (among which to select the one used for licensing procedures), which the system is capable to fulfil. For each *Reference mode*, the supplier shall define the corresponding equipment settings (e.g. the output power) for meeting the requirements (e.g. spectrum mask) of that *Reference mode*. See also clause I.2.

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 Article 1.151 of the Radio Regulations [11] as "*The maximum permissible departure by the centre frequency of the frequency band occupied by an emission from the assigned frequency*".

When operating in the environmental profile declared by the supplier, the maximum allowable RF frequency tolerance shall not exceed, by any reason, the following limits:

| | |
|---|---|
| Equipment operating in bands below 3 GHz: | No requirement, the frequency tolerance shall be included in the applicable spectral density masks. |
| Equipment operating in the band 71 GHz to 86 GHz: | ±50 ppm |
| All other cases: | ±15 ppm |

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 Recommendations ITU-R SM.329-12 [i.61] and Recommendation ITU-R F.1191-3 [i.53] 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 F.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).

When *multi-carrier* systems are concerned, the RSL is intended as the total power integrated for all sub-carriers and, when multiple payload interfaces are also provided (at reference points X', X), the BER shall be evaluated on the worst case interface.

EXAMPLE: In case of two equal sub-carriers, the RSL of each sub-carrier is intended to be 3 dB less than the total RSL power specified in the present document.

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 $10^{-8}$ for systems with minimum RIC ≤ 100 Mbit/s, or $10^{-6}$ and $10^{-10}$ for systems with minimum RIC > 100 Mbit/s).

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 in the field, the switchover among different modes (or different bandwidth for *bandwidth adaptive* systems in 71 GHz to 86 GHz) will happen at suitable RSL thresholds defined by the manufacturer or the operator. See clause I.2.

NOTE 2: 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.

NOTE 3: When planning very short links, where propagation would require fade margins limited to few dB for fulfilling the availability and the SES error performance objectives, a minimum link budget should nevertheless be defined for fulfilling also the "background block error ratio" (BBER) error performance objective. The required RSL for the reaching the RBER (established in EN 302 217-2-1 [i.27]) should be considered.

### 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.27].

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).

When *multi-carrier* systems are concerned, the C/I is intended as the ratio of the total power integrated for all sub-carriers of the wanted and interferer systems, respectively. When multiple payload interfaces are also provided (at reference points X', X), the BER shall be evaluated on the worst case interface.

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 and Ea, giving maximum C/I values for 1 dB and 3 dB degradation of the RSL limits declared by the supplier for a BER ≤ $10^{-6}$ 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**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|
| Reference Index | Class | | | Co-channel Interference | | adjacent channel interference | |
| | | | | 1 dB | 3 dB | 1 dB | 3 dB |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| NOTE: Actual values for this template are found in annexes A to E and Ea. | | | | | | | |

## 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], but not exceeding the maximum upper RSL limit for BER = $10^{-6}$ defined in EN 302 217-2-1 [i.27] clause 6.4.1, 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 $10^{-5}$.

When *multi-carrier* systems are concerned, the wanted signal level is intended as the total power integrated for all sub-carriers and, when multiple payload interfaces are also provided (at reference points X', X), the BER shall be evaluated on the worst case interface.

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 test is not intended to imply a relaxed specification at all out of band frequencies elsewhere specified in EN 302 217 series (e.g. image(s) rejection specified in EN 302 217-2-1 [i.27]).

# 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 [8].

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 [8].

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 [8].

## 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 [8].

### 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 [8].

# 5 Testing for compliance with technical requirements

## 5.1 Environmental and other conditions for testing

### 5.1.1 Environmental conditions

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].

### 5.1.2 Test interpretation and measurement uncertainty

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 (e.g. TR 100 028 [i.29] and, when radiated measurements are concerned, TR 102 215 [i.32]).

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.

### 5.1.3 Other basic conditions

The supplier shall identify the chosen system profile, selected from tables A.2, B.2, C.2, D.2, E.2 and Ea.2.

The system shall be loaded with a continuous data stream at the declared RIC rate (user's interfaces shall be loaded accordingly) and no loss of data shall be experienced (see note).

NOTE: As further guidance, TR 102 565 [i.34] states that the accumulated data rate of all interfaces at X/X' reference point(s) should not be the limiting bottleneck, but the capacity of the radio link. In case that the portion between X/X' and Z/Z' is able to provide control mechanisms for the data stream at X/X', these mechanisms should be configured such that the radio link capacity determines the accepted data rate at X/X'. Figure 1 of EN 302 217-1 [6] defines X/X' and Z/Z' reference interfaces on the generic system block diagram; further guidance can be found in figure 2 of TR 102 565 [i.34].

Systems can, in principle, be fully loaded only in the direction under test; however, when bidirectional systems are assessed, the idle TX co-located to the RX under test, shall transmit its modulated carrier at maximum possible power suitably terminated at the antenna port (reference points C' defined in figure 1 of EN 302 217-1 [6]); however, it may be muted when RX spurious emissions are tested.

When equipment operate with intermittent emissions (i.e. time periods when no net user capacity is transmitted, either for internal system purpose or real transmitter shut down) care should be taken that the tests are not affected by those system shut down periods.

## 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 and power tolerance** | 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) |
| **5.2.4** | **RF Spectrum Mask** | 5.2.6 | X | X | BMT | See note 3 |

| 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 | |
| **5.2.5** | **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.<br>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<br>Required for *mixed-mode* systems only (including *bandwidth adaptive* systems), according clause 5.2.7 of the present document<br>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 and on possible reduction of amount of tests for preset/mixed-mode systems.

## 5.2.1 Transmitter power and power tolerance

Test methods for the transmitter power and transmitter power tolerance may be in accordance with clause 5.2.1 of EN 301 126-1 [3]; other test methods can be adopted provided that technical evidence of their effectiveness is provided.

## 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]. The test shall be carried out at reference climatic conditions.

Other TX and RX Testing shall be carried out with transmitter power level corresponding to:

- ATPC set manually to a fixed value for receiver requirements;
- ATPC set at maximum available power for transmitter requirements.

#### 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.

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 Void

## 5.2.4 RF spectrum mask

Test methods for the RF spectrum masks may be in accordance with clause 5.2.6 of EN 301 126-1 [3]; other test methods can be adopted provided that technical evidence of their effectiveness is provided.

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 frequency, 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 for improving the dynamic range; two step measurement techniques (e.g. separate tests of spectrum density at power amplifier output and of RF filter(s) subsequent attenuation). When sensitivity difficulties are still experienced for reaching the required spectrum mask floor, the supplier shall produce an attachment to the test report with calculated evidence (see similar requirement in clause 5.2.2.1.2 (RTPC test procedure)).

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 ≤ 150** | **CS > 150** |
|---|---|---|---|---|---|---|---|
| **Centre frequency** | fo (see note 1) | | | | | | |
| **Sweep width (MHz)** | ≥ 5 × CS | | | | | | ≥ 5 × CS (for CS < 500)<br>≥ 3 × CS + 1 000 (for CS ≥ 500) |
| **Scan time** | Auto | | | | | | |
| **IF bandwidth (kHz)** | 1 | 3 | 10 | 30 | 100 | 300 | 2 000 |
| **Video bandwidth (kHz)** | 0,003 or 0,03 (note 2) | 0,01 or 0,1 (note 2) | 0,03 or 0,1 (note 2) | 0,1 or 0,3 (note 2) | 0,3 | 0,3 | 3 |

NOTE 1: 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).
NOTE 2: Second values are valid only, as alternative, for equipment assessed before the date of publication of the present document version into the OJEU as harmonized EN R&TTE Directive [1].

### 5.2.5 Discrete CW components exceeding the spectrum mask limit

Test methods for the discrete CW lines exceeding the spectrum mask may be in accordance with clause 5.2.8 of EN 301 126-1 [3] ; other test methods can be adopted provided that technical evidence of their effectiveness is provided.

### 5.2.6 Spurious emissions - external

Test methods for spurious emissions may be in accordance with clause 5.2.9 of EN 301 126-1 [3] ; other test methods can be adopted provided that technical evidence of their effectiveness is provided.

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 (and *bandwidth adaptive* systems in 71 GHz to 86 GHz); 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 (and/or bandwidth, if applicable) switching at the maximum switching speed permitted by the system (see note), the duty cycle for all modulation orders should be kept as equal as possible; each modulation format shall automatically change its maximum rated power for not exceeding the *Reference mode* emission limitations.

NOTE: The change of modulation format (and/or bandwidth, if applicable) could be produced through suitable stimulation of the transmitter or of the corresponding receiver (return link needed).

In this case, the 0 dB reference of the spectral power density mask shall be kept fixed as the one obtained with the *Reference mode* in static conditions. The spectrum mask shall be modified taking into account also the possible in-band additional allowance described in clause 4.2.7 (k1 = +3 dB).

The maximum spectral density in the "max-hold" condition, disregarding, if any, residual of the carrier due to modulation imperfection, shall not exceed, the spectral power density mask of the *Reference mode*, set as described above.

### 5.2.8 Radio frequency tolerance

Test methods for the radio frequency tolerance may be in accordance with clause 5.2.5 of EN 301 126-1 [3]; other test methods can be adopted provided that technical evidence of their effectiveness is provided.

## 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 |
|---|---|---|---|---|---|---|
| | | | Ref | Extreme | B = Bottom M = Middle T = Top | (see note 3) |
| 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 and on possible reduction of amount of tests for *preset/mixed-mode* systems.

## 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 may be in accordance with clause 5.3.2 of EN 301 126-1 [3]; other test methods can be adopted provided that technical evidence of their effectiveness is provided.

## 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-channel* system, clause G.3 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 [8]. | | | | | | |

### 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

This annex contains requirements for a variety of equipment that, depending on the channel arrangements adopted by the local administrations (according clause A.2.1 and table A.1), can offer various transmission capacities within given channel separations using the necessary spectral efficiency class (according clause A.2.2 and table A.2).

## 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) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|---|
| | | | ECC (CEPT/ERC) | ITU-R |
| 1,4 | 1 350 to 1 375 paired with 1 492 to 1 517 | 0,025 to 3,5 | T/R 13-01 annex A [i.17] | F.1242-0 [i.54] |
| 1,4 | 1 375 to 1 400 paired with 1 427 to 1 452 | 0,025 to 3,5 | T/R 13-01 annex B [i.17] | F.1242-0 [i.54] |
| 2,1 | 2 025 to 2 110 paired with 2 200 to 2 290 | 1,75 to 14 | T/R 13-01 annex C [i.17] | F.1098-1 [i.51] |
| 2,6 | 2 520 to 2 593 paired with 2 597 to 2 670 | 1,75 to 14 | See note | F.1243-0 [i.55] |
| 2,4 | 2 300 to 2 500 | 1 and 2 | - | F.746-10 annex 1 [i.47] |
| NOTE: This band was also considered, with the same arrangement of Recommendation ITU-R F.1243-0 [i.55], in annex D of T/R 13-01 [i.17] but it was removed from the 2010 revision. | | | | |

## 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.

Only relatively low capacity systems are considered in these bands; therefore, minimum RIC have been specified only for the channel separations which are multiples of 1,75 MHz. For other channel sizes only indicative channel capacity, in term of gross bit rate, is mentioned for guidance.

- Systems in bands 1,4 GHz and 2,4 GHz — Typical base band data rates are between 9,6 kbit/s and 4 × 2 Mbit/s.
- Systems in bands 2,1 GHz and 2,6 GHz — Typical base band data rates are 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*) and minimum RIC, for ACCP operation**

| Frequency band (GHz) | Channel separation | Spectral efficiency Class 1 equipment (reference index 1) | | Spectral efficiency Class 2 equipment (reference index 2) | | Spectral efficiency Class 4L equipment (reference index 4) | |
|---|---|---|---|---|---|---|---|
| | | Indicative capacity | Min RIC | Indicative capacity | Min RIC | Indicative capacity | Min RIC |
| **1,4** | 25 kHz | 20 kbit/s | - | 32 kbit/s | - | 64 kbit/s | - |
| **1,4** | 75 kHz | 60 kbit/s | - | 95 kbit/s | - | 190 kbit/s | - |
| **1,4** | 250 kHz | 200 kbit/s | - | 325 kbit/s | - | 650 kbit/s | - |
| **1,4** | 500 kHz | 400 kbit/s | - | 650 kbit/s | - | 1 300 kbit/s | - |
| **1,4 and 2,4** | 1 MHz | 800 kbit/s | - | 1 300 kbit/s | - | 2 600 kbit/s | 2 Mbit/s |
| **2,1 and 2,6** | 1,75 MHz | 1 400 kbit/s | - | 2 275 kbit/s | 2 Mbit/s | 4 550 kbit/s | 4 Mbit/s |
| **1,4 and 2,4** | 2 MHz | 1 600 kbit/s | - | 2 600 kbit/s | - | 5 200 kbit/s | - |
| **1,4; 2,1 and 2,6** | 3,5 MHz | 2 800 kbit/s | 2 Mbit/s | 4 500 kbit/s | 4 Mbit/s | 9 100 kbit/s | 8 Mbit/s |
| **2,1 and 2,6** | 7 MHz | Not applicable | | 9 000 kbit/s | 8 Mbit/s | 18 200 kbit/s | 16 Mbit/s |
| **2,1 and 2,6** | 14 MHz | Not applicable | | 18 000 kbit/s | 16 Mbit/s | 38 000 kbit/s | 32 Mbit/s |

# A.3 Transmitter

## A.3.1 General requirements

**Table A.3: Transmitter requirements**

| Requirements | Limits |
|---|---|
| **Maximum transmitter power** | Clause 4.2.1 |
| **Nominal transmitter power tolerance** | Clause 4.2.3 |
| **Transmitter power and frequency control** | Clause 4.2.2 |
| **RF spectrum power density mask** | Clause 4.2.4.2.1 (preferred for CS 1,75 MHz or multiple thereof) or in clause A.3.2 |
| **Discrete CW components exceeding the spectrum mask limit** | 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 within the spectrum mask. 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 RF spectrum masks options

The "unified masks" option in clause 4.2.4.2.1, are valid only for those specific combinations of CS, nominal capacity and spectral efficiency class, that are also included among those foreseen in table A.2.

In addition, with reference to the relevant generic mask shape specified in clause 4.2.4.2.1, table A.4 shows the offset frequency from f0 and attenuation of corner points of "alternative and special spectrum masks", which may also be used for compliance.

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

NOTE: It is reminded that for bands included in this annex A, also unified masks in clause 4.2.4.2.1, exceptionally, do include the frequency tolerance.

**Table A.4: Alternative and special limits of transmitter spectral power density**

| Spectral efficiency | | Frequency band (GHz) | Channel separation (MHz) | K1 (dB) | f1 (kHz) | K2 (dB) | f2 (kHz) | K3 (dB) | f3 (kHz) | K4 (dB) | f4 (kHz) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | |
| 1 and 2 | 1 and 2 | 1,4 | 0,025 | +3 | 12 | -25 | 18 | -25 | 25 | -45 | 40 |
| | | | 0,075 | | 36 | | 54 | | 75 | | 120 |
| | | | 0,250 | | 110 | | 170 | | 230 | | 400 |
| | | | 0,500 | | 210 | | 325 | | 450 | | 800 |
| | | 1,4 and 2,4 | 1 | | 420 | | 650 | | 900 | | 1 600 |
| | | | 2 | | 840 | | 1 300 | | 1 800 | | 3 200 |
| | | 1,4; 2,1 and 2,6 | 3,5 (note 2) | | 1 500 | | 2 400 | | 3 500 | | 6 000 |
| | | 2,1 and 2,6 | 1,75 (note 2) | | 750 | | 1 150 | | 1 600 | | 2 800 |
| | | | 7 (note 2) | | 3 000 | | 4 800 | | 7 000 | | 12 000 |
| | | | 14 (note 2) | | 6 000 | | 9 600 | | 14 000 | | 24 000 |
| 4 | 4L | 1,4 | 0,025 | +1 | 12 | -32 | 18 | -32 | 25 | -55 | 40 |
| | | | 0,075 | | 36 | | 54 | | 75 | | 120 |
| | | | 0,250 | | 110 | | 170 | | 230 | | 400 |
| | | | 0,500 | | 210 | | 325 | | 450 | | 800 |
| | | 1,4 and 2,4 | 1 | | 420 | | 650 | | 900 | | 1 600 |
| | | | 2 | | 840 | | 1 300 | | 1 800 | | 3 200 |
| | | 1,4; 2,1 and 2,6 | 3,5 (note 2) | | 1 500 | | 2 400 | | 3 500 | | 6 000 |
| | | 2,1 and 2,6 | 1,75 (note 2) | | 750 | | 1 150 | | 1 600 | | 2 800 |
| | | | 7 (note 2) | | 3 000 | | 4 800 | | 7 000 | | 12 000 |
| | | | 14 (note 2) | | 6 000 | | 9 600 | | 14 000 | | 24 000 |

NOTE 1: For mask reference shape see figure 4.
NOTE 2: Refer also to the "unified" masks versions in clause 4.2.4.2.1.

# A.4 Receiver

## A.4.1 General requirements

**Table A.5: Receiver requirements**

| Requirements | Limits |
|---|---|
| **Spurious emissions (External)** | Clause 4.3.1 |
| **BER as a function of RSL** | Table A.6 |
| **Co-channel "external" and adjacent channel 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 $\leq 10^{-6}$.

NOTE: RSL for guaranteeing RBER performance may be found in EN 302 217-2-1 [i.27].

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

| Spectral efficiency | | Frequency band (GHz) | Co-polar channel separation | RSL for BER ≤ $10^{-6}$ (dBm) (see note 1) | RSL for BER ≤ $10^{-8}$ (dBm) |
|---|---|---|---|---|---|
| Reference index | Class | | | | |
| 1 | 1 (see note 2) | **1,4** | 25 kHz | -105 | - |
| | | **1,4** | 75 kHz | -100 | - |
| | | **1,4** | 250 kHz | -94 | - |
| | | **1,4** | 500 kHz | -92 | - |
| | | **1,4 and 2,4** | 1 MHz | -89 | - |
| | | **2,1 and 2,6** | 1,75 MHz | -87 | -85,5 |
| | | **1,4 and 2,4** | 2 MHz | -86 | -84,5 |
| | | **1,4; 2,1 and 2,6** | 3,5 MHz | -83 | -81,5 |
| 2 | 2 | **1,4** | 25 kHz | -108 | - |
| | | **1,4** | 75 kHz | -103 | - |
| | | **1,4** | 250 kHz | -97 | - |
| | | **1,4** | 500 kHz | -95 | - |
| | | **1,4 and 2,4** | 1 MHz | -92 | - |
| | | **2,1 and 2,6** | 1,75 MHz | -94 | -92,5 |
| | | **1,4 and 2,4** | 2 MHz | -93 | -91,5 |
| | | **1,4; 2,1 and 2,6** | 3,5 MHz | -91 | -89,5 |
| | | **2,1 and 2,6** | 7 MHz | -88 | -86,5 |
| | | **2,1 and 2,6** | 14 MHz | -85 | -83,5 |
| 4 | 4L | **1,4** | 25 kHz | -101 | - |
| | | **1,4** | 75 kHz | -97 | - |
| | | **1,4** | 250 kHz | -91 | - |
| | | **1,4** | 500 kHz | -89 | - |
| | | **1,4 and 2,4** | 1 MHz | -86 | - |
| | | **2,1 and 2,6** | 1,75 MHz | -87 | -85,5 |
| | | **1,4 and 2,4** | 2 MHz | -86 | -84,5 |
| | | **1,4; 2,1 and 2,6** | 3,5 MHz | -84 | -82,5 |
| | | **2,1 and 2,6** | 7 MHz | -81 | -79,5 |
| | | **2,1 and 2,6** | 14 MHz | -78 | -76,5 |

NOTE 1: For systems operating on CS < 1,75 MHz, 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 justifies 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**

| Spectral efficiency | | Channel separation (MHz) | C/I (dB) for BER ≤ $10^{-6}$ RSL degradation of 1 dB | | |
|---|---|---|---|---|---|
| Reference index | Class | | Co-channel interference C/I (dB) | First adjacent channel interference C/I (dB) | Second adjacent channel interference C/I (dB) |
| **1** | **1** | **0,025 to 14** | 23 | 0 | -25 |
| **2** | **2** | **0,025 to 14** | 23 | 0 | -25 |
| **4** | **4L** | **0,025 to 14** | 30 | 0 | -25 |

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

## B.1 Introduction

This annex contains requirements for a variety of equipment that, depending on the channel arrangements adopted by the local administrations (according clause B.2.1 and table B.1), can offer various transmission capacities within given channel separations using the necessary spectral efficiency class (according clause B.2.2 and table B.2).

## 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) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|---|
| | | | ECC (CEPT/ERC) | ITU-R |
| 3,5 | 3,410 to 3,600 | 1,75 to 14 | 14-03 [i.15] | - |
| 4 | 3,600 to 3,800 | 1,75 to 14 | 12-08 annex B part 2 [i.9] | - |
| | 3,600 to 4,200 | 30 | 12-08 annex A part 2 [i.9] | F.635-6 [i.44] |
| | 3,600 to 4,200 | 60 (see note) | - | - |
| | 3,800 to 4,200 | 29 | 12-08 annex B part 1 [i.9] | F.382-8 [i.36] |
| | 3,800 to 4,200 | 58 (see note) | - | - |
| U4 | 4,400 to 5,000 | 28 and 56 | - | F.1099-4 annex 3 [i.52] |
| | | 60 | - | F.1099-4 annex 1 [i.52] |
| L6 | 5,925 to 6,425 | 29,65 and 59,3 | 14-01 [i.13] | F.383-8 [i.37] |
| U6 | 6,425 to 7,100 | 20 | 14-02 [i.14] | F.384-11 [i.38] |
| | 6,425 to 7,100 | 30 and 60 | 14-02 [i.14] | F.384-11 [i.38] |
| | | 3,5, 7, 14 | 14-02 annex 1 [i.14] | F.384-11 annex 2 [i.38] |
| 7 | 7,125 to 7,425 | 7 to 28 and 56 | - | F.385-10 [i.39] |
| | 7,425 to 7,725 | | - | F.385-10 [i.39] |
| | 7,250 to 7,550 | | - | F.385-10 [i.39] |
| | 7,550 to 7,850 | | - | F.385-10 [i.39] |
| | 7,110 to 7,750 | 28 and 56 | - | F.385-10 annex 3 [i.39] |
| | 7,425 to 7,900 | 7 to 28 and 56 | (02)06 annex 2.2 and annex 3 [i.22] | F.385-10 annex 4 [i.39] |
| | 7,250 to 7,550 | 3,5 to 28 and 56 | - | F.385-10 annex 5 [i.39] |
| | 7,125 to 7,425 | 1,75 to 28 and 56 | (02)06 annexes 1.1, 2.1 and annex 3 [i.22] | F.385-10 annex 1 [i.39] |
| | 7,425 to 7,725 | | (02)06 annex 1.1 and annex 3 [i.22] | F.385-10 annex 1 [i.39] |

| Band (GHz) | Frequency range (GHz) | Channel separation (MHz) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|---|
| | | | ECC (CEPT/ERC) | ITU-R |
| 8 | 7,725 to 8,275 | 7, 14, 28 and 56 | (02)06 annex 1.2.1 and annex 3 [i.22] | - |
| | | 29,65 and 59,3 | (02)06 annex 1.2.2 and annex 3 [i.22] | F.386-8 annex 6 [i.40] |
| | 7,725 to 8,275 | 30 and 60 | - | F.386-8 annex 1 [i.40] |
| | 8,025 to 8,500 | 7 to 28 and 56 | - | F.386-8 annex 5 [i.40] |
| | 8,275 to 8,500 | 7 to 28 and 56 | (02)06 annex 1.3 and annex 3 [i.22] | F.386-8 annex 2 [i.40] |
| | 7,900 to 8,400 | 7 to 28 and 56 | - | F.386-8 annex 3 [i.40] |
| | 7,900 to 8,500 | 1,75 to 28 and 56 | (02)06 annex 2.3 and annex 3 [i.22] | - |
| 10,5 | 10,000 to 10,680 | 3,5 to 28 | - | F.747-1 annex 4 [i.48] |
| | 10,500 to 10,680 | 7 | - | F.747-1 annex 1 [i.48] |
| | 10,150 to 10,3 paired with 10,5 to 10,650 | 3,5 to 28 and 56 | 12-05 [i.6] | F.747-1 annex 3 [i.48] |
| 11 | 10,700 to 11,700 | 7, 14, 28 and 56 | 12-06 [i.7] | F.387-12 annex 4 [i.41] |
| NOTE: In bands from 3,6 GHz to 4,2 GHz, systems with 58/60 MHz CS 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 CS, it is assumed that aggregation of two half sized channels might be permitted on national basis. Also in higher bands the CEPT and Recommendations ITU-R provide the about 60 MHz CS only in term of aggregation of about 2 x 30 MHz CS, subject to their availability and possible national license restrictions. | | | | |

## B.2.2 Transmission capacities

**Table B.2: Minimum RIC transmission capacity and system classes for various channel separation**

| Channel arrangement → | | | Co-polar (ACCP) | | | | | | | Cross-polar (ACAP) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel separation (MHz) → | | | 1,75 | 3,5 | 7 | 14 to 15 | 20 | 28 to 30 | 56 to 60 | 28 to 30 | 56 to 60 |
| Min. payload RIC rate Mbit/s (note 1) | Spectral efficiency ↓ | | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ | ⇩ |
| | Reference Index | Class | | | | | | | | | |
| | 2 | 2 | 2 | 4 | 8 | 16 | - | 32 | 64 | - | - |
| | 3 | 3 | 3 | 6 | 12 | 24 | - | 48 | 96 | - | - |
| | 4 | 4L | 4 | 8 | 16 | 32 | 45 | 64 | 128 | - | - |
| | 5 | 4H | - | - | 24 | 49 | - | 98 | 196 | - | - |
| | 6 | 5L | - | - | 29 | 58 | - | - | - | - | - |
| | | 5LB, 5LA | - | - | - | - | - | 117 | 235 | 117 | 235 |
| | 7 | 5H | - | - | 34 | 68 | - | - | - | - | - |
| | | 5HB, 5HA | - | - | - | - | - | 137 | 274 (note 2) | 137 | 274 (note 2) |
| | 8 | 6L | - | - | 39 | 78 | - | - | - | - | - |
| | | 6LB, 6LA | - | - | - | - | - | 156 | 313 | 156 | 313 |
| | 9 | 6H | - | - | - | 88 | - | - | - | - | - |
| | | 6HB, 6HA | - | - | - | - | - | 176 | 352 | 176 | 352 |
| | 10 | 7 | - | - | - | 98 | - | - | - | - | - |
| | | 7B, 7A | - | - | - | - | - | 196 | 392 | 196 | 392 |
| | 11 | 8 | - | - | - | 107 | - | - | - | - | - |
| | | 8B, 8A | - | - | - | - | - | 215 | 431 | 215 | 431 |
| NOTE 1: For equipment assessment with different base band interfaces see annex F. | | | | | | | | | | | |
| NOTE 2: Equipment requirements are set only on the basis of the RIC rate on one polarization. However, 4 × STM-1 or STM-4 capacity can be possible by doubling 2 × STM-1 equipment either in CCDP operation or through operation of two 2 × STM-1 systems in two 55/56 MHz channels, which, due to spectrum availability, may also not be adjacent. For the assessment of such cases, refer to clause G.3. | | | | | | | | | | | |

# B.3 Transmitter

## B.3.1 General requirements

**Table B.3: Transmitter requirements**

| Requirements | Limits |
|---|---|
| **Maximum transmitter power** | Clause 4.2.1 |
| **Nominal transmitter power tolerance** | Clause 4.2.3 |
| **Transmitter power and frequency control** | Clause 4.2.2 |
| **RF Spectrum power density mask** | Masks in clause 4.2.4.2.1 (preferred) or in clause B.3.2 |
| **Discrete CW components exceeding the spectrum mask limit** | Clause 4.2.5 |
| **Spurious emissions-external** | Clause 4.2.6 |
| **Radio frequency tolerance** | Clause 4.2.8 |

## B.3.2 RF spectrum masks options

The "unified masks" option in clause 4.2.4.2.1, are valid only for those specific combinations of CS, nominal capacity and spectral efficiency class, that are also included among those foreseen in table B.2.

In addition, with reference to the relevant generic mask shape specified in clause 4.2.4.1, table B.4 shows the offset frequency from f0 and attenuation of corner points of "alternative and special spectrum masks" (see note), which may also be used for compliance.

NOTE: Newly assessed equipment are supposed to use the "unified masks" in clause 4.2.4.2.1; masks in table B.4 are supposed, in medium term, to be discontinued.

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: Alternative and special limits of spectral power density**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | | | | |
| **2** | **2** | 2 | 1,75 | Figure 4 | +1 | 0,7 | -23 | 1,4 | -23 | 1,75 | -45 | 3,5 | | |
| | | 4 | 3,5 | | | 1,4 | | 2,8 | | 3,5 | | 7,0 | | |
| | | 8 | 7 | | | 2,7 | | 5,6 | | 6,5 | | 13 | | |
| | | 16 | 14 to 15 | | | 5,4 | | 11,2 | | 13 | | 26 | | |
| | | 32 | 28 to 30 | | | 11,0 | | 19 | | 25 | | 45 | | |
| **4** | **4L** | 4 | 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) | | |
| | | 16 | 7 | | | 2,8 | | 5,6 | | 7 | | 14 (note 1) | | |
| | | 32 | 14 to 15 | | | 5,6 | | 11,2 | | 14 | | 28 (note 1) | | |
| | | 264 | 28 to 30 | | | 11,2 | | 22,4 | | 28 | | 56 (note 1) | | |
| | | 45 | 20 | Figure 5 | +1 | 7,5 | -10 | 9,5 | -33 | 12,5 | -40 | 15 | -55 (note 1) | 30 (note 1) |
| **7** | **5HB** | 34 | 7 | Figure 4 | +1 | 3 | -10 | 3,5 | -30 | 4 | -55 (note 1) | 12,35 (note 1) | | |
| | | 68 | 14 to 15 | | | 6 | | 7 | | 8 | | 24,7 (note 1) | | |

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | | | | |
| 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 second part of 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. NOTE 2: For spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | | | |

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | K1/f1 to K3/f3 (dB/MHz) | K4 (dB) | f4 (MHz) | K5 (dB) | f5 (MHz) |
|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | |
| 4 | 4L | 4 | 1,75 | n.c. | -60 | 4 | | |
| | | 8 | 3,5 | | | 8 | | |
| | | 16 | 7 | | | 16 | | |
| | | 32 | 14 to 15 | | | 31,9 | | |
| | | 64 | 28 to 30 | | | 63,8 | | |
| | | 45 | 20 | | n.c. | n.c. | -60 | 35 |
| 7 | 5HB | 34 | 7 | | -60 | 14 | | |
| | | 68 | 14 to 15 | | | 28 | | |
| n.c.: No change with respect to first part of table B.4. | | | | | | | | |

# B.4 Receiver

## B.4.1 General requirements

**Table B.5: Receiver requirements**

| Requirements | Limits |
|---|---|
| **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.31] and RSL for guaranteeing RBER performance may be found in EN 302 217-2-1 [i.27].

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

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Co-polar channel separation (MHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-8}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|---|
| Reference index | Class | | | | | |
| 2 | 2 | 2 | 1,75 | -93 | -91,5 | - |
| | | 4 | 3,5 | -90 | -88,5 | |
| | | 8 | 7 | -87 | -85,5 | |
| | | 16 | 14 to 15 | -84 | -82,5 | |
| | | 32 | 28 to 30 | -81 | -79,5 | |
| | | 64 | 56 to 60 | -78 | -76,5 | |
| 3 | 3 | 3 | 1,75 | -88 | -86,5 | - |
| | | 6 | 3,5 | -85 | -83,5 | |
| | | 12 | 7 | -82 | -80,5 | |
| | | 24 | 14 to 15 | -79 | -77,5 | |
| | | 48 | 28 to 30 | -76 | -74,5 | |
| | | 96 | 56 to 60 | -73 | -71,5 | |
| 4 | 4L | 4 | 1,75 | -86 | -84,5 | - |
| | | 8 | 3,5 | -83 | -81,5 | |
| | | 16 | 7 | -80 | -78,5 | |
| | | 32 | 14 to 15 | -77 | -75,5 | |
| | | 45 | 20 | -76 | -74,5 | |
| | | 64 | 28 to 30 | -74 | -72,5 | |
| | | 128 | 56 to 60 | -71 | - | -68 |
| 5 | 4H | 24 | 7 | -77 | -75,5 | - |
| | | 49 | 14 to 15 | -74 | -72,5 | - |
| | | 98 | 28 to 30 | -71 | -69,5 | - |
| | | 196 | 56 to 60 | -68 | - | -65 |
| 6 | 5L | 29 | 7 | -74 | -72,5 | |
| | | 58 | 14 to 15 | -71 | -69,5 | |
| | 5LA/5LB (note) | 117 | 28 to 30 (ACAP/ACCP) | -68 | - | -65 |
| | | 235 | 56 to 60 (ACAP/ACCP) | -65 | - | -62 |
| 7 | 5H | 34 | 7 | -72,5 | -71 | - |
| | | 68 | 14 to 15 | -69,5 | -68 | - |
| | 5HA/5HB (note) | 137 | 28 to 30 (ACAP/ACCP) | -67 | - | -64 |
| | | 274 | 56 to 60 (ACAP/ACCP) | -64 | - | -61 |
| 8 | 6L | 39 | 7 | -68 | -66.5 | - |
| | | 78 | 14 to 15 | -65 | -63,5 | - |
| | 6LA/6LB (note) | 156 | 28 to 30 (ACAP/ACCP) | -63 | - | -60 |
| | | 313 | 56 to 60 (ACAP/ACCP) | -60 | - | -57 |
| 9 | 6H | 88 | 14 to 15 | -61 | -59,5 | |
| | 6HA/6HB (note) | 176 | 28 to 30 (ACAP/ACCP) | -58,5 | - | -55,5 |
| | | 352 | 56 to 60 (ACAP/ACCP) | -56 | - | -53 |
| 10 | 7 | 98 | 14 to 15 | -57,5 | -56 | - |
| | 7A/7B (note) | 196 | 28 to 30 (ACAP/ACCP) | -55 | - | -52 |
| | | 392 | 56 to 60 (ACAP/ACCP) | -52,5 | - | -49,5 |
| 11 | 8 | 107 | 14 to 15 | -54,5 | - | -51,5 |
| | 8A/8B (note) | 215 | 28 to 30 (ACAP/ACCP) | -51,5 | - | -48,5 |
| | | 431 | 56 to 60 (ACAP/ACCP) | -49 | - | -46 |

NOTE: For CS 28 MHz to 30 MHz or 56 MHz to 60 MHZ, systems of classes 5LB, 5HB, 6LB, 6HB, 7B and 8B, the limits are required when the connection to the same antenna port of even and odd channels, spaced about 30 MHz or about 60 MHz, respectively, apart on the same polarization, is made with the use of an external 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.

## 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 and first adjacent channel 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**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) (see note) | Channel separation (MHz) (see note) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|
| | | | | Co-channel interference | | First adjacent channel interference | |
| Reference index | Class | | | 1 dB | 3 dB | 1 dB | 3 dB |
| **2** | **2** | 2; 4; 8; 16; 32; 64 | 1,75; 3,5; 7; 14 to 15; 28 to 30; 56 to 60 | 23 | 19 | 0 | -4 |
| **3** | **3** | 3; 6; 12; 24; 48; 96 | 1,75; 3,5; 7; 14 to 15; 28 to 30; 56 to 60 | 27 | 23 | -1 | -5 |
| **4** | **4L** | 4; 8; 16; 32; 64; 128 | 1,75; 3,5; 7; 14 to 15; 28 to 30; 56 to 60 | 30 | 26,5 | -3 | -7 |
| | | 45 | 20 | 30 | 26,5 | -8 | -12 |
| **5** | **4H** | 24; 49; 98; 196 | 7; 14 to 15; 28 to 30; 56 to 60 | 33 | 29 | -5 | -9 |
| **6** | **5L** | 29; 58 | 7; 14 to 15 | 34 | 30 | -3 | -7 |
| | **5LB** | 117; 235 | 28 to 30; 56 to 60 (ACCP) | | | | |
| | **5LA** | 117; 235 | 28 to 30; 56 to 60 (ACAP) | 34 | 30 | 4 | 1 |
| **7** | **5H** | 34; 64 | 7; 14 to 15 | 37 | 33 | -2 | -6 |
| | **5HB** | 137 | 28 to 30; 56 to 60 (ACCP) | 35 | 32 | -5 | -8 |
| | **5HA** | 137; 274 | 28 to 30; 56 to 60 (ACAP) | 37 | 33 | 3 | -1 |
| **8** | **6L** | 39 | 7 | 40 | 36 | 0 | -4 |
| | | 78 | 14 to 15 | | | | |
| | **6LB** | 156; 313 | 28 to 30; 56 to 60 (ACCP) | 40 | 36 | 0 | -4 |
| | **6LA** | 156; 313 | 28 to 30; 56 to 60 (ACAP) | 40 | 36 | 10 | 7 |
| **9** | **6H** | 88 | 14 to 15 | 43 | 39 | 0 | -4 |
| | **6HB** | 176; 352 | 28 to 30; 56 to 60 (ACCP) | | | | |
| | **6HA** | 176; 352 | 28 to 30; 56 to 60 (ACAP) | 43 | 39 | 10 | 6 |
| **10** | **7** | 98 | 14 to 15 | 46 | 42 | 0 | -4 |
| | **7B** | 196; 392 | 28 to 30; 56 to 60 (ACCP) | | | | |
| | **7A** | 196; 392 | 28 to 30; 56 to 60 (ACAP) | 46 | 42 | 13 | 9 |
| **11** | **8** | 107 | 14 to 15 | 50 | 46 | 0 | -4 |
| | **8B** | 215; 431 | 28 to 30; 56 to 60 (ACCP) | | | | |
| | **8A** | 215; 431 | 28 to 30; 56 to 60 (ACAP) | 50 | 46 | 17 | 13 |

NOTE: Minimum RIC and Channel separation series of values in each row are intended one to one coupled in their orders.

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

## C.1 Introduction

This annex contains requirements for equipment that, depending on the 40 MHz channel arrangements adopted by the local administrations (according clause C.2.1 and table C.1), can offer different transmission capacities using the necessary spectral efficiency class (according clause C.2.2 and table C.2).

## 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) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|
| | | CEPT/ECC | ITU-R |
| 4 | 3,600 to 4,200 | 12-08 annex A part 1 [i.9] | F.635-6 [i.44] |
| U4 | 4,400 to 5,000 | - | F.1099-4 annex 1 and annex 2 [i.52] |
| U6 | 6,425 to 7,110 | 14-02 [i.14] | F.384-11 [i.38] |
| 8 | 7,725 to 8,275 | - | F.386-8 annex 4 [i.40] |
| 11 | 10,7 to 11,7 | 12-06 [i.7] | F.387-12 [i.41] |

### C.2.2 Transmission capacities

NOTE: The use in CEPT countries of 40 MHz CS in the bands subject of this annex is generally limited to "high capacity" links. For this reason system with efficiency classes lower than 5L are not provided in the present document. Nevertheless, if lower classes are desired for some special cases, informative reference characteristics (not useable for R&TTE Directive [1] self declaration of conformance) may be derived from the corresponding classes and bands within 28 MHz CS in annex B as follows:

| | |
|---|---|
| # spectrum masks: | frequency corners multiplied by 40/28 |
| # minimum RIC: | multiplied by 40/28 |
| # RSL thresholds: | increased by 10 log (40/28) |
| # Co-channel behaviour: | same |
| # 40 MHz adjacent channel behaviour: | same of that at 28 MHz. |

**Table C.2: Minimum RIC transmission capacity and system classes for various channel separation**

| | | | Channel arrangement → | Co-polar (ACCP) | Cross-polar (ACAP) |
|---|---|---|---|---|---|
| | | | Channel separation → | 40 MHz | 40 MHz |
| Min. payload RIC rate Mbit/s (note 1) | Spectral efficiency ↓ | | | ⇩ | ⇩ |
| | Reference index | Class | | | |
| | 6 | 5LB | | STM-1 or 137 | - |
| | | 5LB | | 168 | - |
| | | 5LA | | - | 168 |
| | 7 | 5HB/28 (note 2) | | STM-1 or 137 | - |
| | | 5HB | | 196 | - |
| | | 5HA | | - | 196 |
| | 8 | 6LA | | - | 224 |
| | | 6LB | | 224 | - |
| | 9 | 6HA (note 3) | | - | 252 |
| | | 6HB (note 3) | | 252 | - |
| | 10 | 7A (note 3) | | - | 280 |
| | | 7B (note 3) | | 280 | - |
| | 11 | 8A | | - | 308 |
| | | 8B | | 308 | - |

NOTE 1: For equipment assessment with different base band interfaces see annex F.
NOTE 2: This case provides system parameters, intended for ACCP or CCDP operation with a minimum RIC that does not fulfil the minimum RIC density established in clause 1.2. This is intended for commonality in order to cover also the 40 MHz channel arrangements with STM-1 systems used in the more popular 28 MHz arrangements.
NOTE 3: Equipment requirements are set only on the basis of the RIC rate on one polarization per 40 MHz channel. However, 4 × STM-1 or STM-4 capacity can be possible by doubling 2 × STM-1 equipment either in CCDP operation or through operation of two 2 × STM-1 systems in two 40 MHz channels, which, due to spectrum availability, may also not be adjacent. For the assessment of such cases, refer to clause G.3.

# C.3 Transmitter

## C.3.1 General requirements

**Table C.3: Transmitter requirements**

| Requirements | Limits |
|---|---|
| **Maximum transmitter power** | Clause 4.2.1 |
| **Nominal transmitter power tolerance** | Clause 4.2.3 |
| **Transmitter power and frequency control** | Clause 4.2.2 |
| **RF Spectrum power density mask** | Masks in clause 4.2.4.2.1 (preferred) or in clause C.3.2 |
| **Discrete CW components exceeding the spectrum mask limit** | Clause 4.2.5 |
| **Spurious emissions-external** | Clause 4.2.6 |
| **Radio frequency tolerance** | Clause 4.2.8 |

## C.3.2 RF spectrum masks

The "unified masks" option in clause 4.2.4.2.1, are valid only for those specific combinations of CS, nominal capacity and spectral efficiency class, that are also included among those foreseen in table C.2. Class 5HB/28 systems shall refer to the corresponding 28 MHz unified mask.

In addition, with reference to the relevant generic mask shape specified in clause 4.2.4.1, table C.4 shows the offset frequency from f0 and attenuation of corner points of "alternative and special spectrum masks" (see note), which may also be used for compliance. (see note).

NOTE: In all cases, newly assessed equipment are supposed to use the "unified masks" in clause 4.2.4.2.1; masks in table C.4 are supposed, in medium term, to be discontinued.

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, systems of spectral efficiency class 6HB with 2 × STM-1 minimum RIC may use, on each polarization, single-carrier or *multi-carrier* 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 spectral power density**

| Spectral efficiency | | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | | | | | | | | |
| **6** | **5LB** | 40 (ACCP) | Figure 5 | +1 | 17 | -10 | 19,5 | -35 | 24 | -40 | 54 | -55 (note 1) | 67 (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 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.

NOTE 2: For spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1

| Spectral efficiency | | Channel separation (MHz) | K1/f1 to, K4/f4 (dB/MHz) | K5 (dB) | f5 (MHz) |
|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | |
| **6** | **5LB** | 40 (ACCP) | n.c. | -60 | 71,3 |

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

# C.4 Receiver

## C.4.1 General requirements

**Table C.5: Receiver requirements**

| Requirements | Limits |
|---|---|
| **Spurious emissions (external)** | Clause 4.3.1 |
| **BER as a function of RSL** | Table C.6 |
| **Co channel external and adjacent channel 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 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.31] and RSL for guaranteeing RBER performance may be found in EN 302 217-2-1 [i.27].

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

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | Frequency band(s) (GHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | |
| **6** | **5LB** | STM-1 or 137 | 40 ACCP | 4, U4, U6, 8 | -69 | -66 |
| | | | | 11 | -68 | -65 |
| | **5LA/5LB** | 168 | | 4, U4, U6, 8 | -68 | -65 |
| | | | | 11 | -67 | -64 |
| **7** | **5HA/5HB** | 196 | 40 ACCP | 4, U4, U6, 8 | -63,5 | -60,5 |
| | | | | 11 | -63,5 | -60,5 |
| | **5HB/28** | STM-1 or 137 | 40 ACCP | 4, U4, U6, 8 | -65 | -62 |
| | | | | 11 | -64 | -61 |
| **8** | **6LA/6LB** | 224 | 40 ACAP/ACCP | 4, U4, U6, 8, 11 | -60,5 | -57,5 |
| **9** | **6HA/6HB** | 252 | 40 ACAP/ACCP | 4, U4, U6, 8, 11 | -57,5 | -54,5 |
| **10** | **7A/7B** | 280 | 40 ACAP/ACCP | 4, U4, U6, 8, 11 | -54 | -51 |
| **11** | **8A/8B** | 308 | 40 ACAP/ACCP | 4, U4, U6, 8, 11 | -50,5 | -47,5 |

NOTE: These limits are required when the connection to the same antenna port of even and odd channels, spaced 40 MHz apart on the same polarization, is made with the use of an external 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.

## 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 ≤ $10^{-6}$ in clause C.4.2.

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

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|
| | | | | Co-channel interference | | First adjacent channel interference | |
| **Reference index** | **Class** | | | **1 dB** | **3 dB** | **1 dB** | **3 dB** |
| **6** | **5LA** | 168 | 40 (ACAP) | 33 | 29 | 3 | 0 |
| | **5LB** | STM-1 or 137 | 40 (ACCP) | 33 | 29 | -4 | -8 |
| | | 168 | | 33 | 29 | -3 | -7 |
| **7** | **5HA** | 196 | 40 (ACCP) | 37 | 33 | 7 | 4 |
| | **5HB/28** | STM-1 or 137 | 40 (ACCP) | 37 | 33 | -4 | -8 |
| | **5HB** | 196 | 40 (ACCP) | 37 | 33 | -3 | -7 |
| **8** | **6LA** | 224 | 40 (ACAP) | 40 | 36 | 10 | 7 |
| | **6LB** | 224 | 40 (ACCP) | 40 | 36 | 0 | -4 |
| **9** | **6HA** | 252 | 40 (ACAP) | 43 | 39 | 10 | 7 |
| | **6HB** | 252 | 40 (ACCP) | 43 | 39 | 0 | -4 |
| **10** | **7A** | 280 | 40 (ACAP) | 46 | 42 | 13 | 9 |
| | **7B** | 280 | 40 (ACCP) | 46 | 42 | 0 | -4 |
| **11** | **8A** | 308 | 40 (ACAP) | 50 | 46 | 17 | 13 |
| | **8B** | 308 | 40 (ACCP) | 50 | 46 | 0 | -4 |

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

## D.1 Introduction

This annex contains requirements for a variety of equipment that, depending on the channel arrangements adopted by the local administrations (according clause D.2.1 and table D.1), can offer various transmission capacities within given channel separations using the necessary spectral efficiency class (according clause D.2.2 and table D.2).

## 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) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|---|
| | | | ECC (CEPT/ERC) | ITU-R |
| 13 | 12,75 to 13,25 | 1,75 to 28 | 12-02E [i.4] | F.497-7 [i.42] |
| 13 | 12,75 to 13,25 | 56 (note 3) | 12-02E [i.4] | F.497-7 [i.42] |
| 15 | 14,5 to14,62 paired with 15,23 to 15,35 | 1,75 to 56 | 12-07 [i.8] | F.636-4 [i.45] |
| | 14,5 to 15,35 | | - | |
| 18 | 17,7 to 19,700 | 13,75 to 110 or 1,75 to 14 (note 2) | 12-03 [i.5] (note 1) | F.595-10 [i.43] (note 1) |

NOTE 1: CEPT Recommendation 12-03 [i.5] allows for low-capacity channel arrangements on a national basis. Recommendation ITU-R F.595-10 [i.43] 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 in 18 GHz band 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: In the 13 GHz band the CEPT and Recommendations ITU-R provide the 56 MHz CS only in term of aggregation of 2 × 28 MHz CS, subject to their availability and possible national license restrictions.

## D.2.2 Transmission capacities

**Table D.2: Minimum RIC transmission capacity and system classes for various channel separation**

| Channel arrangement → | | | Co-polar (ACCP) | | | | | | | Cross-polar (ACAP) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel separation (MHz) → | | | 1,75 | 3,5 | 7 | 13,75/14 | 27,5/28 | 55/56 | 110 (18 GHz) | 27,5 /28 | 55/56 | 110 (18 GHz) |
| Min. payload RIC rate Mbit/s (note 1) | Spectral Efficiency ↓ | | | | | | | | | | | |
| | Reference index | Class | | | | | | | | | | |
| | 2 | 2 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | - | - | - |
| | 3 | 3 | 3 | 6 | 12 | 24 | 48 | 96 | 191 | - | - | - |
| | 4 | 4L | 4 | 8 | 16 | 32 | 64 | 128 | 256 | - | - | - |
| | 5 | 4H | - | sSTM-14 (note 2) | 24 | 49 | 98 | 196 | 392 | - | - | - |
| | 6 | 5L | - | - | 29 | 58 | - | - | - | - | - | - |
| | | 5LB, 5LA | - | - | - | - | 117 | 235 | 470 | 117 | 235 | 470 |
| | 7 | 5H | - | sSTM-22 (note 2) | 34 | 68 | - | - | - | - | - | - |
| | | 5HB, 5HA | - | - | - | - | 137 (note 3) | 274 (note 3) | 548 | 137 (note 3) | 274 (note 3) | 548 |
| | 8 | 6L | - | - | 39 | 78 | - | - | - | - | - | - |
| | | 6LB, 6LA | - | - | - | - | 156 (note 3) | 313 (note 3) | 627 | 156 (note 3) | 314 (note 3) | 627 |
| | 9 | 6H | - | - | - | 88 | - | - | - | - | - | - |
| | | 6HB, 6HA | - | - | - | - | 176 | 352 | 705 | 176 | 352 | 705 |
| | 10 | 7 | - | - | - | 98 | - | - | - | - | - | - |
| | | 7B, 7A | - | - | - | - | 196 | 392 | 784 | 196 | 392 | 784 |
| | 11 | 8 | - | - | - | 107 | - | - | - | - | - | - |
| | | 8B, 8A | - | - | - | - | 215 | 431 | 862 | 215 | 431 | 862 |

NOTE 1: For equipment assessment with different base band interfaces see annex F.
NOTE 2: These systems are standardized only for these sub-STM-0 capacity (defined in Recommendation ITU-T G.708 [i.63]).
NOTE 3: Equipment requirements are set only on the basis of the RIC rate on one polarization. However, 4 × STM-1 or STM-4 capacity can be possible by doubling 2 × STM-1 equipment either in CCDP operation or through operation of two 2 × STM-1 systems in two separate 55/56 MHz channels, which, due to spectrum availability, may also not be adjacent. For the assessment of such cases, refer to clause G.3.

# D.3 Transmitter

## D.3.1 General requirements

**Table D.3: Transmitter Requirements**

| Requirements | Limits |
|---|---|
| **Maximum transmitter power** | Clause 4.2.1 |
| **Nominal transmitter power tolerance** | Clause 4.2.3 |
| **Transmitter power and frequency control** | Clause 4.2.2 |
| **RF spectrum power density mask** | Masks in clause 4.2.4.2.1 (preferred) or in clause D.3.2 |
| **Discrete CW components exceeding the spectrum mask limit** | Clause 4.2.5 |
| **Spurious emissions-external** | Clause 4.2.6 |
| **Radio frequency tolerance** | Clause 4.2.8 |

## D.3.2 RF spectrum masks options

The "unified masks" option in clause 4.2.4.2.1, are valid only for those specific combinations of CS, nominal capacity and spectral efficiency class, that are also included among those foreseen in table D.2.

In addition, with reference to the relevant generic mask shape specified in clause 4.2.4.1, tables D.4a and D.4b show the offset frequency from f0 and attenuation of corner points of "alternative and special spectrum masks" (see note), which may also be used for compliance.

NOTE: Newly assessed equipment are supposed to use the "unified masks" in clause 4.2.4.2.1; masks in tables D.4a and D.4b are supposed, in medium term, to be discontinued.

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.4a: Alternative and special limits of spectral power density (13 GHz and 15 GHz only)**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | | | | | | | |
| **3** | **2** | **2** | **1,75** | Figure 4 | +1 | 0,7 | -23 | 1,4 | -23 | 1,75 | -45 | 3,5 |
| | | **4** | **3,5** | | | 1,4 | | 2,8 | | 3,5 | | 7 |
| | | **8** | **7** | | | 2,7 | | 5,6 | | 6,5 | | 13 |
| | | **16** | **14** | | | 5,4 | | 11,2 | | 13 | | 26 |
| | | **32** | **28** | | | 11 | | 19 | | 25 | | 45 |
| **4** | **4L** | **4** | **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 |
| | | **16** | **7** | | | 2,8 | | 5,6 | | 7 | | 14 |
| | | **32** | **14** | | | 5,6 | | 11,2 | | 14 | | 28 |
| | | **64** | **28** | | | 11,2 | | 22,4 | | 28 | | 56 |
| NOTE: For Spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | |

**Table D.4b: Alternative and special limits of spectral power density (18 GHz only)**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | | | | | | | |
| **2** | **2** | **2** | **1,75** | Figure 4 | +1 | 0,7 | -23 | 1,4 | -23 | 1,75 | -45 | 3,5 |
| | | **4** | **3,5** | | | 1,4 | | 2,8 | | 3,5 | | 7 |
| | | **8** | **7** | | | 2,7 | | 5,6 | | 6,5 | | 13 |
| | | **16** | **14/13,75** | | | 5,4 | | 11,2 | | 13 | | 26 |
| | | **32** | **27,5** | | | 11 | | 19 | | 25 | | 45 |
| **4** | **4L** | **4** | **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 |
| | | **16** | **7** | | | 2,8 | | 5,6 | | 7 | | 12 |
| | | **32** | **14/13,75** | | | 5,6 | | 11,2 | | 14 | | 24 |
| | | **64** | **27,5** | | | 11,2 | | 22,4 | | 28 | | 48 |
| **5** | **4H** | **sSTM-14 (9,792 Mbit/s)** | **3,5** | Figure 4 | +1 | 1,4 | -30 | 2,8 | -35 | 3,5 | -50 | 5,45 |
| **7** | **5B** | **sSTM-22 (14,4 Mbit/s)** | **3,5** | | | 1,4 | | 2,8 | | 3,5 | -50 | 5,45 |
| **4** | **4L** | **128** | **55** | Figure 4 | +1 | 22,5 | -30 | 33 | -40 | 70 | -50 | 80 |
| NOTE: For Spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | |

# D.4 Receiver

## D.4.1 General requirements

**Table D.5: Receiver requirements**

| Requirements | Limits |
|---|---|
| **Spurious emissions (External)** | Clause 4.3.1 |
| **BER as a function of RSL** | Table D.6a (equipment operating in 13 GHz and 15 GHz bands)<br>Table D.6b (equipment operating in 18 GHz band) |
| **Co channel external and adjacent channel 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 tables D.6a and D.6b. 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.31] and RSL for guaranteeing RBER performance may be found in EN 302 217-2-1 [i.27].

**Table D.6a: BER as a function of receiver input signal level RSL (upper bound) for 13 GHz and 15 GHz bands**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-8}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | |
| **2** | **2** | 2 | 1,75 | -93 | -91,5 | - |
| | | 4 | 3,5 | -90 | -88,5 | - |
| | | 8 | 7 | -87 | -85,5 | - |
| | | 16 | 14 | -84 | -82,5 | - |
| | | 32 | 28 | -81 | -79,5 | - |
| | | 64 | 56 | -78 | -76,5 | - |
| **3** | **3** | 3 | 1,75 | -88 | -86,5 | |
| | | 6 | 3,5 | -85 | -83,5 | |
| | | 12 | 7 | -82 | -80,5 | |
| | | 24 | 14 | -79 | -77,5 | |
| | | 48 | 28 | -76 | -74,5 | |
| | | 96 | 56 | -73 | -71,5 | |
| **4** | **4L** | 4 | 1,75 | -86 | -84,5 | - |
| | | 8 | 3,5 | -83 | -81,5 | - |
| | | 16 | 7 | -80 | -78,5 | - |
| | | 32 | 14 | -77 | -75,5 | - |
| | | 64 | 28 | -74 | -72,5 | - |
| | | 128 | 56 | -71 | - | -68 |
| **5** | **4H** | 24 | 7 | -77 | -75,5 | - |
| | | 49 | 14 | -74 | -72,5 | - |
| | | 98 | 28 | -71 | -69,5 | - |
| | | 196 | 56 | -68 | - | -65 |
| **6** | **5L** | 29 | 7 | -74 | -72,5 | - |
| | | 58 | 14 | -71 | -69,5 | - |
| | **5LA/5LB (note)** | 117 | 28 (ACAP/ACCP) | -68 | - | -65 |
| | | 235 | 56 (ACAP/ACCP) | -65 | - | -62 |
| **7** | **5H** | 34 | 7 | -71,5 | -70 | - |
| | | 68 | 14 | -68,5 | -67 | - |
| | **5HA/5HB (note)** | 137 | 28 (ACAP/ACCP) | -65,5 | - | -62,5 |
| | | 274 | 56 (ACAP/ACCP) | -62 | - | -59 |

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-8}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | |
| **8** | **6L** | 39 | 7 | -67,5 | -66 | - |
| | | 78 | 14 | -64,5 | -63 | - |
| | **6LA/6LB (note)** | 156 | 28 (ACAP/ACCP) | -62 | | -59 |
| | | 313 | 56 (ACAP/ACCP) | -59 | | -56 |
| **9** | **6H** | 88 | 14 | -61 | -59,5 | - |
| | **6HA/6HB (note)** | 176 | 28 (ACAP/ACCP) | -58,5 | - | -55,5 |
| | | 352 | 56 (ACAP/ACCP) | -56 | - | -53 |
| **10** | **7** | 98 | 14 | -57,5 | -56 | - |
| | **7A/7B (note)** | 196 | 28 (ACAP/ACCP) | -55 | - | -52 |
| | | 392 | 56 (ACAP/ACCP) | -52,5 | - | -49,5 |
| **11** | **8** | 107 | 14 | -54,5 | - | -51,5 |
| | **8A/8B (note)** | 215 | 28 (ACAP/ACCP) | -51,5 | - | -48,5 |
| | | 431 | 56 (ACAP/ACCP) | -49 | - | -46 |
| NOTE: For CS 28 MHz or 56 MHz, systems of classes 5HB, 6LB and 7B, the limits are required when the connection to the same antenna port of even and odd channels, spaced 28 MHz or 56 MHz, respectively, apart on the same polarization, is made with the use of an external 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. | | | | | | |

**Table D.6b: BER as a function of receiver input signal level RSL (upper bound) for 18 GHz bands**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-8}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | |
| **2** | **2** | 2 | 1,75 | -92 | -90,5 | - |
| | | 4 | 3,5 | -89 | -87,5 | - |
| | | 8 | 7 | -86 | -84,5 | - |
| | | 16 | 14/13,75 | -83 | -81,5 | - |
| | | 32 | 27,5 | -80 | -78,5 | - |
| | | 64 | 55 | -77 | -75,5 | - |
| | | 128 | 110 | -74 | - | -71 |
| **3** | **3** | 3 | 1,75 | -87 | -85,5 | |
| | | 6 | 3,5 | -84 | -82,5 | |
| | | 12 | 7 | -81 | -79,5 | |
| | | 24 | 14/13,75 | -78 | -76,5 | |
| | | 48 | 27,5 | -75 | -73,5 | |
| | | 96 | 55 | -72 | -70,5 | |
| | | 191 | 110 | -69 | - | -66 |
| **4** | **4L** | 4 | 1,75 | -85 | -83,5 | - |
| | | 8 | 3,5 | -82 | -80,5 | - |
| | | 16 | 7 | -79 | -77,5 | - |
| | | 32 | 14/13,75 | -76 | -74,5 | - |
| | | 64 | 27,5 | -73 | -71,5 | - |
| | | 128 | 55 | -70 | | -67 |
| | | 256 | 110 | -67 | - | -64 |
| **5** | **4H** | sSTM-14 | 3,5 | -78 | -76,5 | - |
| | | 24 | 7 | -76 | -74,5 | - |
| | | 49 | 14/13,75 | -73 | -71,5 | - |
| | | 98 | 27,5 | -70 | -68,5 | - |
| | | 196 | 55 | -67 | - | -64 |
| | | 392 | 110 | -64 | - | -61 |
| **6** | **5L** | 29 | 7 | -73 | -71,5 | - |
| | | 58 | 14/13,75 | -70 | -68,5 | - |
| | **5LA/5LB (note)** | 117 | 27,5 | -67 | - | -64 |
| | | 235 | 55 | -64 | - | -61 |
| | | 470 | 110 | -61 | - | -58 |

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Channel separation (MHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-8}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|---|
| **Reference index** | **Class** | | | | | |
| **7** | **5H** | sSTM-22 | 3,5 | -73 | -71,5 | - |
| | | 34 | 7 | -70 | -68,5 | - |
| | | 68 | 13,75 | -67 | -65,5 | - |
| | **5HA/5HB (note)** | 137 | 27,5 (ACAP/ACCP) | -64 | - | -61 |
| | | 274 | 55 (ACAP/ACCP) | -61 | - | -58 |
| | | 548 | 110 (ACAP/ACCP) | -58 | - | -55 |
| **8** | **6L** | 39 | 7 | -66 | -64,5 | - |
| | | 78 | 13,75/14 | -63,5 | -62 | - |
| | **6LA/6LB (note)** | 156 | 27,5 (ACAP/ACCP) | -61 | - | -58 |
| | | 313 | 55 (ACAP/ACCP) | -58 | - | -55 |
| | | 627 | 110 (ACAP/ACCP) | -55 | - | -52 |
| **9** | **6H** | 88 | 13,75/14 | -60 | -58,5 | - |
| | **6HA/6HB (note)** | 176 | 27,5 (ACAP/ACCP) | -57,5 | - | -54,5 |
| | | 352 | 55 (ACAP/ACCP) | -55 | - | -52 |
| | | 705 | 110 (ACAP/ACCP) | -52 | - | -49 |
| **10** | **7** | 98 | 13,75/14 | -56,5 | -55 | - |
| | **7A/7B (note)** | 196 | 27,5 (ACAP/ACCP) | -54 | - | -51 |
| | | 392 | 55 (ACAP/ACCP) | -51,5 | - | -48,5 |
| | | 784 | 110 (ACAP/ACCP) | -49 | - | -46 |
| **11** | **8** | 107 | 13,75/14 | -53,5 | - | -50,5 |
| | **8A/8B (note)** | 215 | 27,5 (ACAP/ACCP) | -50,5 | - | -47,5 |
| | | 431 | 55 (ACAP/ACCP) | -48 | - | -45 |
| | | 862 | 110 (ACAP/ACCP) | -45,5 | - | -42,5 |
| NOTE: For CS 27,5 MHz or 55 MHz, systems of classes 5HB, 6LB and 7B, the limits are required when the connection to the same antenna port of even and odd channels, spaced 27,5 MHz or 55 MHz, respectively, apart on the same polarization, is made with the use of an external 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. | | | | | | |

## 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 ≤ $10^{-6}$ in clause D.4.2.

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

| Spectral efficiency | | Minimum RIC rate (Mbit/s) (see note) | Channel separation (MHz) (see note) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|
| | | | | Co-channel interference | | adjacent channel interference | |
| **Reference index** | **Class** | | | **1 dB** | **3 dB** | **1 dB** | **3 dB** |
| **2** | **2** | 2; 4; 8; 16; 32; 64 | 1,75; 3,5; 7; 14; 28; 56 | 23 | 19 | 0 | -4 |
| | | 16; 32; 64; 128 | 13,75; 27,5; 55; 110 | 23 | 19 | 1 | -3 |
| **3** | **3** | 3; 6; 12; 24; 48 | 1,75; 3,5; 7; 14; 28; 56 | 27 | 24,5 | -1 | -5 |
| | | 24; 48; 96; 191 | 13,75; 27,5; 55; 110 | 27 | 24,5 | -0 | -4 |
| **4** | **4L** | 4; 8; 16; 32; 64 | 1,75; 3,5; 7; 14; 28 | 30 | 26,5 | -1 | -5 |
| | | 32; 64 | 13,75; 27,5 | 30 | 26,5 | 0 | -4 |
| | | 128; 256 | 55/56; 110 | 29 | 25 | -5 | -9 |
| **5** | **4H** | sSTM-14 | 3,5 | 30 | 26 | -4 | -8 |
| | | 24; 49; 98; 196 | 7; 14; 28; 56 | 30 | 26,5 | -6 | -9,5 |
| | | 49; 98; 196; 392 | 13,75; 27,5; 55; 110 | 30 | 26,5 | -2 | -5,5 |
| **6** | **5L** | 29; 58 | 7; 13,75/14 | 34 | 30 | -3 | -7 |
| | **5LB** | 117; 235; 470 | 27,5/28; 55/56; 110 (ACCP) | 34 | 30 | -3 | -7 |
| | **5LA** | 117; 235; 470 | 27,5/28; 55/56; 110 (ACAP) | 34 | 30 | 4 | 1 |

| Spectral efficiency | | Minimum RIC rate (Mbit/s) (see note) | Channel separation (MHz) (see note) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|
| | | | | Co-channel interference | | adjacent channel interference | |
| Reference index | Class | | | 1 dB | 3 dB | 1 dB | 3 dB |
| 7 | 5H | sSTM-22 | 3,5 | 37 | 33 | 0 | -4 |
| | | 34; 68 | 7; 13,75/14 | 37 | 33 | -3,5 | -7,5 |
| | 5HB | 137 | 28 | 35 | 32 | -5 | -8 |
| | | | 27,5 | 37 | 33 | -3 | -7 |
| | | 274 | 55/56 | 37 | 33 | -3,5 | -7,5 |
| | | 548 | 110 | 37 | 33 | -3,5 | -7,5 |
| | 5HA | 137; 274; 548 | 27,5/28; 55/56; 110 (ACAP) | 37 | 33 | 3 | -1 |
| 8 | 6L | 39; 78 | 7; 13,75/14 | 40 | 36 | 0 | -4 |
| | 6LB | 156; 313; 627 | 27,5/28; 55/56; 110 (ACCP) | 40 | 36 | 0 | -4 |
| | 6LA | 156; 313; 627 | 27,5/28; 55/56; 110 (ACAP) | 40 | 36 | 10 | 7 |
| 9 | 6H | 88 | 13,75/14 | 43 | 39 | 0 | -4 |
| | 6HB | 176; 352; 705 | 27,5/28; 55/56; 110 (ACCP) | | | | |
| | 6HA | 176; 352; 705 | 27,5/28; 55/56; 110 (ACAP) | 43 | 39 | 10 | 6 |
| 10 | 7 | 98 | 13,75/14 | 46 | 42 | 0 | -4 |
| | 7B | 196; 392; 784 | 27,5/28; 55/56; 110 (ACCP) | 46 | 42 | 0 | -4 |
| | 7A | 196; 392; 784 | 27,5/28; 55/56; 110 (ACAP) | 46 | 42 | 13 | 9 |
| 11 | 8 | 107 | 13,75/14 | 50 | 46 | 0 | -4 |
| | 8B | 215; 431; 862 | 27,5/28; 55/56; 110 (ACCP) | | | | |
| | 8A | 215; 431; 862 | 27,5/28; 55/56; 110 (ACAP) | 50 | 46 | 17 | 13 |

NOTE: Minimum RIC and Channel separation series of values in each row are intended one to one coupled in their orders.

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

## E.1 Introduction

This annex contains requirements for a variety of equipment that, depending on the channel arrangements adopted by the local administrations (according clause E.2.1 and table E.1), can offer various transmission capacities within given channel separations using the necessary spectral efficiency class (according clause E.2.2 and table E.2).

## 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) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|---|
| | | | ECC (CEPT/ERC) | ITU-R |
| **23** | 22,0 to 23,6 | 3,5 to 112 | T/R 13-02 [i.18] | F.637-4 [i.46] |
| **26** | 24,5 to 26,5 | 3,5 to 112 | T/R 13-02 [i.18] | F.748-4 [i.49] |
| **28** | 27,5 to 29,5 | 3,5 to 112 | T/R 13-02 [i.18] | F.748-4 [i.49] |
| **31** | 31,0 to 31,3 | 3,5 to 28/56 (see note) | 02-02 [i.21] | F.746-10 annex 7 [i.47] |
| **32** | 31,8 to 33,4 | 3,5 to 112 | 01-02 [i.3] | F.1520-3 [i.58] |
| **38** | 37,0 to 39,5 | 3,5 to 112 | T/R 12-01 [i.16] | F.749-3 [i.50] |
| **42** | 40,5 to 43,5 | 7 to 112 | 01-04 [i.19] | F.2005 [i.59] |
| **50** | 48,5 to 50,2 | 3,5 to 28 | 12-10 [i.10] | - |
| **52** | 51,4 to 52,6 | 3,5 to 56 | 12-11 [i.11] | F.1496-1 [i.56] |
| **55** | 55,78 to 57,0 | 3,5 to 56 | 12-12 [i.12] | F.1497-1 [i.57] |
| NOTE: In 31 GHz band, no Recommended CEPT or ITU-R radio frequency channel arrangements providing for 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

**Table E.2: Minimum RIC transmission capacity and system classes for various channel separation**

| | Channel arrangement → | | | Co-polar (ACCP) | | | | | | Cross-polar (ACAP) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Channel separation (MHz) → | | | 3,5 | 7 | 14 | 28 | 56 | 112 | 28 | 56 | 112 |
| Minimum payload RIC rate Mbit/s (note 1) | Spectral efficiency ↓ | | Frequency band (GHz) ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ | ↓ ↓ |
| | Reference index | Class | | | | | | | | | | |
| | 1 | 1 | 50 | 2 | - | - | - | - | | - | - | - |
| | | | 52; 55 | 2 | 4 | 8 | 16 | 32 | | - | - | - |
| | 2 | 2 | 23 to 38 | 4 | 8 | 16 | 32 | 64 | 128 | - | - | - |
| | | | 42 | - | 8 | 16 | 32 | 64 | 128 | - | - | - |
| | | | 50 | 4 | 8 | 16 | 32 | - | - | - | - | - |
| | | | 52; 55 | 4 | 8 | 16 | 32 | 64 | - | - | - | - |
| | 3 | 3 | 23 to 38 | 6 | 12 | 24 | 48 | 96 | 191 | - | - | - |
| | | | 42 | - | 12 | 24 | 48 | 96 | 191 | - | - | - |
| | | | 50 | 6 | 12 | 24 | 48 | - | - | - | - | - |
| | | | 52; 55 | 6 | 12 | 24 | 48 | 96 | - | - | - | - |
| | 4 | 4L | 23 to 38 | 8 | 16 | 32 | 64 | 128 | 256 | - | - | - |
| | | | 42 | - | 16 | 32 | 64 | 128 | 256 | - | - | - |
| | | | 50 | 8 | 16 | 32 | 64 | - | - | - | - | - |
| | | | 52; 55 | 8 | 16 | 32 | 64 | 128 | - | - | - | - |
| | 5 | 4H | 23 to 42 | - | 24 | 49 | 98 | 196 | 392 | - | - | - |
| | 6 | 5L | 23 to 42 | - | 29 | 58 | - | - | - | - | - | - |
| | | 5LB, 5LA | 23 to 42 | - | - | - | 117 | 235 | 470 | 117 | 235 | 470 |
| | 7 | 5H | 23 to 42 | - | 34 | 68 | - | - | - | - | - | - |
| | | 5HB, 5HA | 23 to 42 | - | - | - | 137 (note 2) | 274 (note 2) | 548 | 137 (note 2) | 274 (note 2) | 548 |
| | 8 | 6L | 23 to 42 | - | 39 | 78 | - | - | - | - | - | - |
| | | 6LB, 6LA | 23 to 42 | - | - | - | 156 | 313 | 627 | 156 | 313 | 627 |
| | 9 | 6H | 23 to 42 | - | - | 88 | - | - | - | - | - | - |
| | | 6HB, 6HA | 23 to 42 | - | - | - | 176 | 352 | 705 | 176 | 352 | 705 |
| | 10 | 7 | 23 to 42 | - | - | 98 | - | - | - | - | - | - |
| | | 7B, 7A | 23 to 42 | - | - | - | 196 | 392 | 784 | 196 | 392 | 784 |
| | 11 | 8 | 23 to 42 | - | - | 107 | - | - | - | - | - | - |
| | | 8B, 8A | 23 to 42 | - | - | - | 215 | 431 | 862 | 215 | 431 | 862 |

NOTE 1: For equipment assessment with different base band interfaces see annex F.
NOTE 2: Equipment requirements are set only on the basis of the RIC rate on one polarization. However, 4 × STM-1 or STM-4 capacity can be possible by doubling 2 × STM-1 equipment either in CCDP operation, or through operation of two 2 × STM-1 systems in two separate 56 MHz channels, which, due to spectrum availability, may also not be adjacent. For the assessment of such cases, refer to clause G.3.

# E.3 Transmitter

## E.3.1 General requirements

**Table E.3: Transmitter requirements**

| Requirements | Limits |
|---|---|
| **Maximum transmitter power** | Clause 4.2.1 |
| **Nominal transmitter power tolerance** | Clause 4.2.3 |
| **Transmitter power and frequency control** | Clause 4.2.1 |
| **RF Spectrum power density mask** | Masks in clause 4.2.4.2.1 (preferred) or in clause E.3.2 |
| **Discrete CW components exceeding the spectrum mask limit** | Clause 4.2.5 |
| **Spurious emissions-external** | Clause 4.2.6 |
| **Radio frequency tolerance** | Clause 4.2.8 |

## E.3.2 RF spectrum masks options

The "unified masks" option in clause 4.2.4.2.1, are valid only for those specific combinations of CS, nominal capacity and spectral efficiency class, that are also included among those foreseen in table E.2.

In addition, with reference to the relevant generic mask shape specified in clause 4.2.4.1, tables E.4 to E.6a and E.6b show the offset frequency from f0 and attenuation of corner points of "alternative and special spectrum masks" (see note), which may also be used for compliance.

NOTE: Newly assessed equipment is supposed to use the "unified masks" in clause 4.2.4.2.1; masks in tables E.4 to E.6 are supposed, in medium term, to be discontinued. This is particularly valid for 42 GHz band, made available to P-P applications only in 2010.

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.

### E.3.2.1 Frequency bands 23 GHz to 42 GHz

**Table E.4: Alternative and special limits of spectral power density for bands from 23 GHz to 28 GHz**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | | |
| 2 | 2 | 4 | 3,5 | Figure 4 | +1 | 1,4 | -23 | 2,8 | -23 | 3,5 | -45 | 7 |
| | | 8 | 7 | | | 2,8 | | 5,6 | | 7 | | 14 |
| | | 16 | 14 | | | 5,6 | | 11,2 | | 14 | | 28 |
| | | 32 | 28 | | | 11 | | 19 | | 25 | | 45 |
| 4 | 4L | 8 | 3,5 | Figure 4 | +1 | 1,4 | -30 | 2,8 | -35 | 3,5 | -50 | 6,15 |
| | | 16 | 7 | | | 2,8 | | 5,6 | | 7 | | 12,25 |
| | | 32 | 14 | | | 5,6 | | 11,2 | | 14 | | 24,5 |
| | | 64 | 28 | | | 11,2 | | 22,4 | | 28 | | 49 |
| | | 128 | 56 | | | 22,5 | | 33 | | 65 | | 74 |
| NOTE: For Spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | |

**Table E.5: Alternative and special limits of spectral power density for bands 31 GHz, 32 GHz, 38 GHz, 42 GHz**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | | |
| 2 | 2 | 4 | 3,5 | Figure 4 | +1 | 1,4 | -23 | 2,8 | -23 | 3,5 | -45 | 7 |
| | | 8 | 7 | | | 2,8 | | 5,6 | | 7 | | 14 |
| | | 16 | 14 | | | 5,6 | | 11,2 | | 14 | | 28 |
| | | 32 | 28 | | | 11 | | 19 | | 25 | | 45 |
| 4 | 4L | 8 | 3,5 | Figure 4 | +1 | 1,4 | -30 | 2,8 | -35 | 3,5 | -45 | 5,25 |
| | | 16 | 7 | | | 2,8 | | 5,6 | | 7 | | 10,5 |
| | | 32 | 14 | | | 5,6 | | 11,2 | | 14 | | 21 |
| | | 64 | 28 | | | 11,2 | | 22,4 | | 28 | | 42 |
| | | 128 | 56 | | | 22,5 | | 33 | | 65 | | 71 |
| NOTE: For Spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | |

### E.3.2.2 Frequency bands 50 GHz to 55 GHz

**Table E.6a: Alternative and special limits of spectral power density 50 GHz band**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | | |
| 1 | 1 | 2 | 3,5 | Figure 4 | 0 | 1,3 | -25 | 2,6 | -25 | 3,2 | -45 | 5,2 |
| 2 | 2 | 4 | 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 |
| | | 16 | 14 | | | 5,2 | | 10,4 | | 12,8 | | 20,8 |
| | | 32 | 28 | | | 10,5 | | 19 | | 24,5 | | 35,5 |
| NOTE: For Spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | |

**Table E.6b: Alternative and special limits of spectral power density 52 GHz and 55 GHz bands**

| Spectral efficiency | | Minimum RIC 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | | | | | | | | | | |
| 1 | 1 | 4 | 7 | Figure 4 | +1 | 3,3 | -25 | 6,1 | -25 | 6,8 | -45 | 12,8 |
| | | 8 | 14 | | | 6 | | 11,6 | | 13 | | 22 |
| | | 16 | 28 | | | 12 | | 24,2 | | 26 | | 45 |
| | | 32 | 56 | | | 24 | | 50 | | 60 | | 80 |
| 2 | 2 | 4 | 3,5 | Figure 4 | +1 | 1,4 | -23 | 2,8 | | 3,5 | -45 | 7 |
| | | 8 | 7 | | | 2,8 | | 5,6 | | 7 | | 14 |
| | | 16 | 14 | | | 5,6 | | 11,2 | | 14 | | 28 |
| | | 32 | 28 | | | 11 | | 19 | | 25 | | 45 |
| 3 | 3 | 47 | 28 | Figure 4 | +1 | 10,5 | -30 | 18 | -35 | 28 | -45 | 33 |
| 4 | 4L | 8 | 3,5 | Figure 4 | +1 | 1,4 | -30 | 2,8 | -35 | 3,5 | -45 | 5,85 |
| | | 16 | 7 | | | 2,8 | | 5,6 | | 7 | | 11,67 |
| | | 32 | 14 | | | 5,6 | | 11,2 | | 14 | | 23,35 |
| | | 64 | 28 | | | 11,2 | | 22,4 | | 28 | | 46,7 |
| | | 128 | 56 | | | 22,5 | | 33 | | 65 | | 75 |
| NOTE: For Spectrum masks of classes not mentioned in this table, refer only to the "unified" versions in clause 4.2.4.2.1. | | | | | | | | | | | | |

## E.4 Receiver

### E.4.1 General requirements

**Table E.7: Receiver requirements**

| Requirements | Limits |
|---|---|
| **Spurious emissions (external)** | Clause 4.3.1 |
| **BER as a function of RSL** | Tables E.8a and E.8b (equipment operating from 23 GHz to 42 GHz)<br>Table E.9 (equipment operating from 50 GHz to 55 GHz) |
| **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.31] and RSL for guaranteeing RBER performance may be found in EN 302 217-2-1 [i.27].

## E.4.2.1 Systems in bands from 23 GHz to 42 GHz

**Table E.8a: BER performance thresholds for 23 GHz to 42 GHz bands (systems for minimum RIC < 100 Mbit/s) (upper bound)**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Band → | 23 GHz band | | 26 GHz and 28 GHz bands | | 31 GHz and 32 GHz band | | 38 GHz band | | 42 GHz band | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | 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) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-8}$ (dBm) |
| 2 | 2 | 4 | 3,5 | -89 | -87,5 | -88 | -86,5 | -88 | -86,5 | -87 | -85,5 | | |
| | | 8 | 7 | -86 | -84,5 | -85 | -83,5 | -85 | -83,5 | -84 | -82,5 | -84 | -82,5 |
| | | 16 | 14 | -83 | -81,5 | -82 | -80,5 | -82 | -80,5 | -81 | -79,5 | -81 | -79,5 |
| | | 32 | 28 | -80 | -78,5 | -79 | -77,5 | -79 | -77,5 | -78 | -76,5 | -78 | -76,5 |
| | | 64 | 56 | -77 | -75,5 | -76 | -74,5 | -76 | -74,5 | -75 | -73,5 | -75 | -73,5 |
| 3 | 3 | 6 | 3,5 | -84 | -82,5 | -83 | -81,5 | -83 | -81,5 | -82 | -80,5 | | |
| | | 12 | 7 | -81 | -79,5 | -80 | -78,5 | -80 | -78,5 | -79 | -77,5 | -79 | -77,5 |
| | | 24 | 14 | -78 | -76,5 | -77 | -75,5 | -77 | -75,5 | -76 | -74,5 | -76 | -74,5 |
| | | 48 | 28 | -75 | -73,5 | -74 | -72,5 | -74 | -72,5 | -73 | -71,5 | -73 | -71,5 |
| | | 96 | 56 | -72 | -70,5 | -71 | -69,5 | -71 | -69,5 | -70 | -68,5 | -70 | -68,5 |
| 4 | 4L | 8 | 3,5 | -82 | -80,5 | -81 | -79,5 | -81 | -79,5 | -80 | -78,5 | | |
| | | 16 | 7 | -79 | -77,5 | -78 | -76,5 | -78 | -76,5 | -77 | -75,5 | -77 | -75,5 |
| | | 32 | 14 | -76 | -74,5 | -75 | -73,5 | -75 | -73,5 | -74 | -72,5 | -74 | -72,5 |
| | | 64 | 28 | -73 | -71,5 | -72 | -70,5 | -72 | -70,5 | -71 | -69,5 | -71 | -69,5 |
| 5 | 4H | 24 | 7 | -76 | -74,5 | -75 | -73,5 | -75 | -73,5 | -74 | -72,5 | -74 | -72,5 |
| | | 49 | 14 | -73 | -71,5 | -72 | -70,5 | -72 | -70,5 | -71 | -69,5 | -71 | -69,5 |
| | | 98 | 28 | -70 | -68,5 | -69 | -67,5 | -69 | -67,5 | -68 | -66,5 | -68 | -66,5 |
| 6 | 5L | 29 | 7 | -73 | -71,5 | -72 | -70,5 | -71,5 | -70 | -70,5 | -69 | -70,5 | -69 |
| | | 58 | 14 | -70 | -68,5 | -69 | -67,5 | -69 | -67,5 | -68 | -66,5 | -68 | -66,5 |
| 7 | 5H | 34 | 7 | -70 | -68,5 | -69 | -67,5 | -68 | -66,5 | -67 | -65,5 | -67 | -65,5 |
| | | 68 | 14 | -67 | -65,5 | -66 | -64,5 | -66 | -64,5 | -65 | -63,5 | -64,5 | -63 |
| 8 | 6L | 39 | 7 | -66 | -64,5 | -65 | -63,5 | -64,5 | -63 | -63,5 | -62 | -63,5 | -62 |
| | | 78 | 14 | -63,5 | -62 | -62,5 | -61 | -62 | -60,5 | -61 | -59,5 | -61 | -59,5 |
| 9 | 6H | 88 | 14 | -60 | -58,5 | -59 | -57,5 | -59 | -57,5 | -57,5 | -56 | -57,5 | -56 |
| 10 | 7 | 98 | 14 | -56,5 | -55 | -55,5 | -54 | -55,5 | -54 | -54,5 | -53 | -54,5 | -53 |

**Table E.8b: BER performance thresholds for 23 GHz to 42 GHz bands (systems for minimum RIC ≥ 100 Mbit/s) (upper bound)**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Band → | 23 GHz band | | 26 GHz and 28 GHz bands | | 31 GHz and 32 GHz band | | 38 GHz band | | 42 GHz band | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | Channel separation (MHz) ↓ | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
| **2** | **2** | **128** | **112** | -74 | -71 | -73 | -70 | -73 | -70 | -72 | -69 | -72 | -69 |
| **3** | **3** | **191** | **112** | -69 | -66 | -68 | -65 | -68 | -65 | -67 | -64 | -67 | -64 |
| **4** | **4L** | **128** | **56** | -70 | -67 | -69 | -66 | -69 | -66 | -68 | -65 | -68 | -65 |
| | | **256** | **112** | -67 | -64 | -66 | -63 | -66 | -63 | -65 | -62 | -65 | -62 |
| **5** | **4H** | **196** | **56** | -67 | -64 | -66 | -63 | -66 | -63 | -65 | -62 | -65 | -62 |
| | | **392** | **112** | -64 | -61 | -63 | -60 | -63 | -60 | -62 | -59 | -62 | -59 |
| **6** | **5LA/5LB** | **117** | **28** | -67 | -64 | -66 | -63 | -66 | -63 | -65 | -62 | -65 | -62 |
| | | **235** | **56** | -64 | -61 | -63 | -60 | -63 | -60 | -62 | -59 | -62 | -59 |
| | | **470** | **112** | -61 | -58 | -60 | -57 | -60 | -57 | -59 | -56 | -59 | -56 |
| **7** | **5HA/5HB** | **137** | **28** | -64 | -61 | -63 | -60 | -63 | -60 | -62 | -59 | -62 | -59 |
| | | **274 (note)** | **56** | -61 | -58 | -60 | -57 | -60 | -57 | -59 | -56 | -59 | -56 |
| | | **548** | **112** | -58 | -55 | -57 | -54 | -57 | -54 | -56 | -53 | -56 | -53 |
| **8** | **6LA/6LB** | **156** | **28** | -61 | -58 | -60 | -57 | -59,5 | -56,5 | -58,5 | -55,5 | -58,5 | -55,5 |
| | | **313** | **56** | -58 | -55 | -57 | -54 | -57 | -54 | -56 | -53 | -56 | -53 |
| | | **627** | **112** | -55 | -52 | -54 | -51 | -54 | -51 | -53 | -50 | -53 | -50 |
| **9** | **6HA/6HB** | **176** | **28** | -57,5 | -54,5 | -56,5 | -53,5 | -56 | -53 | -55 | -52 | -55 | -52 |
| | | **352** | **56** | -55 | -52 | -54 | -51 | -53,5 | -50,5 | -52,5 | -49,5 | -52,5 | -49,5 |
| | | **705** | **112** | -52 | -49 | -51 | -48 | -51 | -48 | -50 | -47 | -50 | -47 |
| **10** | **7A/7B** | **196** | **28** | -54 | -51 | -53 | -50 | -52,5 | -49,5 | -51,5 | -48,5 | -51,5 | -48,5 |
| | | **392** | **56** | -51,5 | -48,5 | -50,5 | -47,5 | -50 | -47 | -49 | -46 | -49 | -46 |
| | | **784** | **112** | -49 | -46 | -48 | -45 | -47,5 | -44,5 | -46,5 | -43,5 | -46,5 | -43,5 |
| **11** | **8A/8B** | **107** | **14** | -53,5 | -50,5 | -52,5 | -49,5 | -52,5 | -49,5 | -51,5 | -48,5 | -51,5 | -48,5 |
| | | **215** | **28** | -50,5 | -47,5 | -49,5 | -46,6 | -49,5 | -46,5 | -48,5 | -45,5 | -48,5 | -45,5 |
| | | **431** | **56** | -48 | -45 | -47 | -44 | -46,5 | -43,5 | -46 | -43 | -46 | -43 |
| | | **862** | **112** | -45,5 | -42,5 | -44,5 | -41,5 | -44 | -41 | -43 | -40 | -43 | -40 |

NOTE: Equipment requirements are set only on the basis of the RIC rate on one polarization. However, 4 × STM-1 or STM-4 capacity can be possible by doubling 2 × STM-1 equipment either in CCDP operation, or through operation of two 2 × STM-1 systems in two separate 56 MHz channels, which, due to spectrum availability, may not be adjacent. For the assessment of such cases, refer to clause G.3.

### E.4.2.2 Systems in bands from 50 GHz to 55 GHz

**Table E.9: BER performance thresholds for 50 GHz to 55 GHz (upper bound)**

| Spectral efficiency | | Minimum RIC rate (Mbit/s) | Band → | 50 GHz | | 52 GHz and 55 GHz | | |
|---|---|---|---|---|---|---|---|---|
| Reference index | Class | | 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 ≤ $10^{-10}$ (dBm) |
| 1 | 1 | 2 | 3,5 | -89 | -87,5 | -88 | -86,5 | - |
| | | 4 | 7 | - | - | -85 | -83,5 | - |
| | | 8 | 14 | - | - | -82 | -80,5 | - |
| | | 16 | 28 | - | - | -79 | -77,5 | - |
| | | 32 | 56 | - | - | -76 | -74,5 | - |
| 2 | 2 | 4 | 3,5 | -86 | -84,5 | -85 | -83,5 | - |
| | | 8 | 7 | -83 | -81,5 | -82 | -80,5 | - |
| | | 16 | 14 | -80 | -78,5 | -79 | -77,5 | - |
| | | 32 | 28 | -77 | -75,5 | -76 | -74,5 | - |
| | | 64 | 56 | - | - | -73 | -71,5 | - |
| 3 | 3 | 6 | 3,5 | -80,5 | -79 | -79,5 | -78 | - |
| | | 12 | 7 | -77,5 | -76 | -76,5 | -75 | |
| | | 24 | 14 | -74,5 | -73 | -73,5 | -72 | |
| | | 48 | 28 | -71,5 | -70 | -70,5 | -69 | |
| | | 96 | 56 | - | - | -67,5 | -66 | |
| 4 | 4L | 8 | 3,5 | -78,5 | -77 | -77,5 | -76 | - |
| | | 16 | 7 | -75,5 | -74 | -74,5 | -73 | - |
| | | 32 | 14 | -73 | -71,5 | -72 | -70,5 | - |
| | | 64 | 28 | -70 | -68,5 | -69 | -67,5 | - |
| | | 128 | 56 | - | - | -66 | - | -63 |

## 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**

| Spectral efficiency | | Frequency band (GHz) | Minimum RIC rate (Mbit/s) (see note) | Channel separation (MHz) (see note) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Co-channel interference | | Adjacent channel interference | |
| Reference index | Class | | | | 1 dB | 3 dB | 1 dB | 3 dB |
| 1 | 1 | 50, 52, 55 | 2 | 3,5 | 23 | 19 | 0 | -4 |
| | | 52, 55 | 4; 8; 16; 32 | 7; 14; 28; 56 | | | | |
| 2 | 2 | All except 42 | 4 | 3,5 | 23 | 19 | 0 | -4 |
| | | All | 8; 16; 32 | 7; 14; 28 | | | | |
| | | All except 50 | 64 | 56 | | | | |
| | | 23 to 42 | 128 | 112 | | | | |
| 3 | 3 | All except 42 | 6 | 3,5 | 23 | 19 | -1 | -5 |
| | | All | 12; 24; 48 | 7; 14; 28 | | | | |
| | | All except 50 | 96 | 56 | | | | |
| | | 23 to 42 | 191 | 112 | | | | |
| 4 | 4L | All except 42 | 8 | 3,5 | 30 | 26 | -1 | -5 |
| | | All | 16; 32; 64 | 7; 14; 28 | | | | |
| | | All except 50 | 128 | 56 | | | | |
| | | 23 to 42 | 256 | 112 | | | | |
| 5 | 4H | 23 to 42 | 24; 49; 98; 196; 392 | 7; 14; 28; 56; 112 | 30 | 26 | -6 | -9,5 |
| 6 | 5L | 23 to 42 | 29; 58 | 7; 14 | 34 | 30 | -3 | -7 |
| | 5LB | 23 to 42 | 117; 235; 470 | 28; 56; 112 (ACCP) | 34 | 30 | -3 | -7 |
| | 5LA | 23 to 42 | 117; 235; 470 | 28; 56; 112 (ACAP) | 34 | 30 | 4 | 1 |
| 7 | 5H | 23 to 42 | 34; 68 | 7; 14 | 37 | 33 | -3 | -7 |
| | 5HB | 23 to 42 | 137 | 28 (ACCP) | | | | |
| | | | 274; 548 | 56; 112 (ACCP) | 37 | 33 | -3,5 | -7,5 |
| | 5HA | 23 to 42 | 137; 274; 548 | 28; 56; 112 (ACAP) | 37 | 33 | +3 | -1 |
| 8 | 6L | 23 to 42 | 39; 78 | 7; 14 | 40 | 36 | 0 | -4 |
| | 6LB | 23 to 42 | 156; 313; 627 | 28; 56; 112 (ACCP) | | | | |
| | 6LA | 23 to 42 | 156; 313; 627 | 28; 56; 112 (ACAP) | 40 | 36 | 10 | 7 |
| 9 | 6H | 23 to 42 | 88 | 14 | 43 | 39 | 0 | -4 |
| | 6HB | 23 to 42 | 176; 352; 705 | 28; 56; 112 (ACCP) | | | | |
| | 6HA | 23 to 42 | 176; 352; 705 | 28; 56; 112 (ACAP) | 43 | 39 | 10 | 6 |
| 10 | 7 | 23 to 42 | 98 | 14 | 46 | 42 | 0 | -4 |
| | 7B | 23 to 42 | 196; 392; 784 | 28; 56; 112 (ACCP) | | | | |
| | 7A | 23 to 42 | 196; 392; 784 | 28; 56; 112 (ACAP) | 46 | 42 | 13 | 9 |
| 11 | 8 | 23 to 42 | 107 | 14 | 50 | 46 | 0 | -4 |
| | 8B | 23 to 42 | 215; 431; 862 | 28; 56; 112 (ACCP) | | | | |
| | 8A | 23 to 42 | 215; 431; 862 | 28; 56; 112 (ACAP) | 50 | 46 | 17 | 13 |

NOTE: Minimum RIC and Channel separation series of values in each row are intended one to one coupled in their orders.

# Annex Ea (normative): Frequency bands from 71 GHz to 86 GHz

## Ea.1 Introduction

This annex provides requirements that are intended as "additive" to the "minimal" requirements provided by EN 302 217-3 [7] for Category 2 equipment for the same bands, which are generally valid when conventional link-by-link frequency coordination is not applied. This additional set is intended to be appropriate when conventional link-by-link frequency coordination is applied based on specific channel arrangements provided by ECC/REC(05)07 [i.23] (see note).

NOTE: According ECC/REC(05)07 [i.23] administrations may chose not to adopt any channel arrangement; however, the general common minimal requirement for systems in these frequency bands, set in EN 302 217-3 [7], provides that in such case the nominal channel bandwidth, in terms of n × 250 MHz basic channels, is considered to be the size of their closest aggregation wider than the actual occupied bandwidth. Therefore, the "additional" requirements reported in the present document may still be applied whenever the supplier prefers to declare conformity to R&TTE Directive [1] also according the present document. It is assumed that declaration of conformity to R&TTE Directive [1] according the present document to be always combined with conformity also to EN 302 217-3 [7]. It should also be noted that EN 302 217-3 [7] contains a reference to some receiver parameters reported in the present document, which assessment, according to EN 302 217-3 [7] alone, is only "recommended" as helpful practice; when additional assessment according the present document is preferred, the receiver requirements referred in this annex become mandatory.

The requirements in this annex cover a variety of equipment that, depending on the channel arrangements adopted by the local administrations (according clause Ea.2.1 and table Ea.1), can offer various transmission capacities within given channel separations using the necessary spectral efficiency class (according clause Ea.2.2 and table Ea.2).

## Ea.2 General characteristics

### Ea.2.1 Frequency characteristics and channel arrangements

In table Ea.1, ITU-R and ECC 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 "additional" parameters and test suites, provided by the present document, relevant to each system designed for that channel separation.

Other national or future ITU-R or ECC recommendations (see note) 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.

NOTE: In some case block assignment may also be applied; in such case additional "licensing conditions" (e.g. block edges masks) might be required by local administrations.

**Table Ea.1: Frequency characteristics**

| Band (GHz) | Frequency range (GHz) | Channel separation (MHz) (see note 1) | Recommendations for radio frequency channel arrangements | |
|---|---|---|---|---|
| | | | ECC | ITU-R |
| **70** | 71,0 to 76,0 | 250 to 2 250 (9 × 250) | 05-07 [i.23] | F.2006 [i.60] |
| **80** | 81,0 to 86,0 | | | |
| **70 paired with 80** | 71,0 to 76,0 paired with 81,0 to 86,0 | 250 to 4 500 (18 × 250) | | |
| **70 (upper part) paired with 80 (upper part) (see note 2)** | 74,0 to 76,0 paired with 84,0 to 86,0 | 250 to 1 750 (7 × 250) | | |
| **70 and 80** | 71,0 to 76,0 and 81,0 to 86,0 | Free (see note 3) | | |
| **70 and 80** | 71,0 to 76,0 and 81,0 to 86,0 | Block (see note 3) | | |

NOTE 1: The present document provides system parameters only up to 2 000 MHz.
NOTE 2: Typically used in countries where the lower part of the two bands are allocated to military applications.
NOTE 3: See the note in clause Ea.1.

## Ea.2.2 Transmission capacities

**Table Ea.2: Minimum RIC transmission capacity and system classes for various channel separation**

| Channel separation (MHz) → | | | 250 | 500 | 750 | 1 000 | 1 250 | 1 500 | 1 750 | 2 000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Minimum payload RIC rate Mbit/s (note 2) | Spectral efficiency ↓ | | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| | Reference index | Class | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| | **1** | **1** | 142 | 285 | 427 | 570 | 712 | 855 | 997 | 1 140 |
| | **2** | **2** | 285 | 570 | 855 | 1 140 (note 1) | 1 425 | 1 710 | 1 995 | 2 280 |
| | **3** | **3** | 425 | 850 | 1 275 | 1 700 | 2 125 (note 1) | 2 550 | 2 975 | 3 400 |
| | **4** | **4L** | 570 | 1 140 (note 1) | 1 710 | 2 280 (note 1) | 2 850 | - | - | - |
| | **5** | **4H** | 875 | 1 750 | 2 625 | - | - | - | - | - |
| | **6** | **5LA/5LB** | 1 050 (note 1) | 2 100 (note 1) | 3 150 (note 1) | - | - | - | - | - |
| | **7** | **5HA/5HB** | 1 225 | 2 450 | - | - | - | - | - | - |
| | **8** | **6LA/6LB** | 1 400 | 2 800 | - | - | - | - | - | - |

NOTE 1: RIC rounded down to closest multiple of 1 Gbit/s rate shall also be considered valid.
NOTE 2: For equipment assessment with different base band interfaces see annex F.

# Ea.3 Transmitter

## Ea.3.1 General requirements

**Table Ea.3: Transmitter requirements**

| Requirements (see note) | Limits |
|---|---|
| **Maximum transmitter power** | Clause 4.2.1 |
| **Nominal transmitter power tolerance** | Clause 4.2.3 |
| **Transmitter power and frequency control** | Clause 4.2.1 |
| **RF Spectrum power density mask** | Masks in clause 4.2.4.2.1 |
| **Discrete CW components exceeding the spectrum mask limit** | Clause 4.2.5 |
| **Spurious emissions-external** | Clause 4.2.6 |
| **Radio frequency tolerance** | Clause 4.2.8 |
| NOTE: Equipment conforming to the present document shall also conform to EN 302 217-3 [7], annex UC. | |

## Ea.3.2 RF spectrum masks

The "unified masks" options in clause 4.2.4.2.1, are valid only for those specific combinations of CS, nominal capacity and spectral efficiency class, that are also included among those foreseen in table Ea.2.

No "alternative and special spectrum masks" are foreseen in this frequency range.

Spectrum masks are not inclusive of an allowance for radio frequency tolerance. Centre frequency f0 identifies the actual carrier frequency.

**Table Ea.4: Void**

# Ea.4 Receiver

## Ea.4.1 General requirements

**Table Ea.5: Receiver requirements**

| Requirements (see note) | Limits |
|---|---|
| **Spurious emissions (external)** | Clause 4.3.1 |
| **BER as a function of RSL** | Table Ea.6 |
| **Co channel external and adjacent channel interference sensitivity** | Table Ea.7 |
| **CW spurious interference** | Clause 4.3.4 |
| NOTE: Equipment conforming to the present document shall also conform to EN 302 217-3 [7] annex UC; however, it formally imply only the same Spurious emissions (external) requirement. | |

## Ea.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 tables Ea.5. The declared Receiver Signal levels shall produce a BER of either $\leq 10^{-6}$ or $\leq 10^{-10}$ as required.

NOTE: RSL for guaranteeing RBER performance may be found in EN 302 217-2-1 [i.27].

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

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Channel separation (MHz) | RSL for BER ≤ $10^{-6}$ (dBm) | RSL for BER ≤ $10^{-10}$ (dBm) |
|---|---|---|---|---|---|
| Reference index | Class | | | | |
| 1 | 1 | 142 | 250 | -66 | -64 |
| | | 285 | 500 | -63 | -61 |
| | | 427 | 750 | -61 | -59 |
| | | 570 | 1 000 | -60 | -58 |
| | | 712 | 1 250 | -59 | -57 |
| | | 855 | 1 500 | -58 | -56 |
| | | 997 | 1 750 | -57,5 | -55,5 |
| | | 1 140 | 2 000 | -57 | -55 |
| 2 | 2 | 285 | 250 | -64 | -62 |
| | | 570 | 500 | -61 | -59 |
| | | 855 | 750 | -59 | -57 |
| | | 1 140 (note) | 1 000 | -58 | -56 |
| | | 1 425 | 1 250 | -57 | -55 |
| | | 1 710 | 1 500 | -56 | -54 |
| | | 1 995 | 1 750 | -55,5 | -53,5 |
| | | 2 280 | 2 000 | -55 | -53 |
| 3 | 3 | 425 | 250 | -61 | -59 |
| | | 850 | 500 | -58 | -56 |
| | | 1 275 | 750 | -56 | -54 |
| | | 1 700 | 1 000 | -55 | -53 |
| | | 2 125 (note) | 1 250 | -54 | -52 |
| | | 2 550 | 1 500 | -53 | -51 |
| | | 2 975 | 1 750 | -52,5 | -50,5 |
| | | 3 400 | 2 000 | -52 | -50 |
| 4 | 4L | 570 | 250 | -58,5 | -54,5 |
| | | 1 140 (note) | 500 | -55,5 | -51,5 |
| | | 1 710 | 750 | -53,5 | -49,5 |
| | | 2 280 (note) | 1 000 | -52,5 | -48,5 |
| | | 2 850 | 1 250 | -51,5 | -47,5 |
| 5 | 4H | 875 | 250 | -55 | -51 |
| | | 1 750 | 500 | -52 | -48 |
| | | 2 625 | 750 | -50 | -46 |
| 6 | 5LA/5LB | 1 050 (note) | 250 | -51,5 | -47,5 |
| | | 2 100 (note) | 500 | -48,5 | -44,5 |
| | | 3 150 (note) | 750 | -46,5 | -42,5 |
| 7 | 5HA/5HB | 1 250 | 250 | -48 | -44 |
| | | 2 450 | 500 | -45 | -41 |
| 8 | 6LA/6LB | 1 400 | 250 | -44 | -40 |
| | | 2 800 | 500 | -41 | -37 |

NOTE: RIC rounded down to closest multiple of 1 Gbit/s rate shall also be considered valid.

## Ea.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 Ea.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 Ea.4.2.

**Table Ea.7: Co-channel and adjacent channel interference sensitivity**

| Spectral efficiency | | Min. RIC rate (Mbit/s) | Channel separation (MHz) | C/I for BER ≤ $10^{-6}$ RSL degradation of 1 dB or 3 dB | | | |
|---|---|---|---|---|---|---|---|
| | | | | Co-channel interference | | Adjacent channel interference | |
| Reference. Index | Class | | | 1 dB | 3 dB | 1 dB | 3 dB |
| 1 or 2 | 1 or 2 | 142 or 285 | 250 | 23 | 19 | 0 | -4 |
| | | 285 or 570 | 500 | | | | |
| | | 427 or 855 | 750 | | | | |
| | | 570 or 1 140 (note) | 1 000 | | | | |
| | | 712 or 1 425 | 1 250 | | | | |
| | | 855 or 1 710 | 1 500 | | | | |
| | | 997 or 1 995 | 1 750 | | | | |
| | | 1 140 or 2 280 | 2 000 | | | | |
| 3 | 3 | 425 | 250 | 25 | 21 | 0 | -4 |
| | | 850 | 500 | | | | |
| | | 1 275 | 750 | | | | |
| | | 1 700 | 1 000 | | | | |
| | | 2 125 (note) | 1 250 | | | | |
| | | 2 550 | 1 500 | | | | |
| | | 2 975 | 1 750 | | | | |
| | | 3 400 | 2 000 | | | | |
| 4 | 4L | 570 | 250 | 27 | 23 | 0 | -4 |
| | | 1 140 (note) | 500 | | | | |
| | | 1 710 | 750 | | | | |
| | | 2 280 (note) | 1 000 | | | | |
| | | 2 850 | 1 250 | | | | |
| 5 | 4H | 875 | 250 | 30 | 26 | -2 | -6 |
| | | 1 750 | 500 | | | | |
| | | 2 625 | 750 | | | | |
| 6 | 5LB | 1 050 (note) | 250 (ACCP) | 33,5 | 29,5 | -6 | -10 |
| | | 2 100 (note) | 500 (ACCP) | | | | |
| | | 3 150 (note) | 750 (ACCP) | | | | |
| | 5LA | 1 050 (note) | 250 (ACAP) | 33,5 | 29,5 | +3 | -1 |
| | | 2 100 (note) | 500 (ACAP) | | | | |
| | | 3 150 (note) | 750 (ACAP) | | | | |
| 7 | 5HB | 1 225 | 250 (ACCP) | 37 | 33 | -3 | -7 |
| | | 2 450 | 500 (ACCP) | | | | |
| | 5HA | 1 225 | 250 (ACAP) | 37 | 33 | +6 | +2 |
| | | 2 450 | 500 (ACAP) | | | | |
| 8 | 6LB | 1 400 | 250 (ACCP) | 40,5 | 36,5 | 0 | -4 |
| | | 2 800 | 500 (ACCP) | | | | |
| | 6LA | 1 400 | 250 (ACAP) | 40,5 | 36,5 | +9 | +5 |
| | | 2 800 | 500 (ACAP) | | | | |
| NOTE: RIC rounded down to closest multiple of 1 Gbit/s rate shall also be considered valid. | | | | | | | |

# Annex F (normative): Definition of equivalent data rates for packet data, PDH/SDH and other signals on the traffic interface

## F.1 Introduction

This annex provides the conditions under which the BER oriented specifications can be used for systems with traffic interface other than PDH/SDH.

## 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 the information provided, for the selected spectral efficiency class, in the main body and the relevant annexes.

### F.2.2 Transmission capacities

Tables from F.1a to F.1h show the minimum RIC (Radio Interface Capacity) required for the assessment of radio systems in the scope of the present document. All spectral efficiency classes are listed even if for some cases the relevant system parameters are not presently provided in the present document. In some other cases, minimum equivalent PDH/SDH rates are not defined.

The minimum RIC values for each CS are derived from the minimum RIC density values given in table 0 of the main body of the present document rounded down to closer suitable values. The RIC density is defined as the RIC per unit bandwidth, Mbit/s/MHz (see note).

NOTE: Minimum RIC values for classes 4L and lower fit both the RIC and the RIC density derived from older V1.1.3 of the present document; classes 4H and higher are linearly derived (in both CS and spectral efficiency index) from the RIC density of the corresponding 28 MHz cases in the said V1.1.3 of the present document.

The minimum RIC is valid when the system is not exclusively offering PDH or SDH interface combinations; tables F.1a through F.1h, valid for CS 1,75 MHz through 112 MHz, give also the minimum transmission capacity in term of the number of equivalent 2,048 Mbit/s PDH streams that shall be transported either aggregated into higher PDH/SDH hierarchy or as separate streams, directly multiplexed into the proprietary radio frame. The shown hierarchic aggregated interfaces are just examples offering the minimum number of 2,048 Mbit/s PDH streams, other hierarchic combinations are also possible (e.g. $3 \times$ STM-1 plus $1 \times$ STM-0 in place of $10 \times$ STM-0).

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 and receiver requirements. The supplier may choose which class to declare.

For CS size $N \times 250$ MHz (defined only in the 71 GHz to 86 GHz in annex Ea), even if no specific equivalence tables are here defined, PDH or SDH interface combinations are possible provided that the overall RIC fulfil the relevant minimum RIC requirement reported in table Ea.2.

**Table F.1a: Minimum RIC and equivalent PDH/SDH capacity for CS = 1,75 MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| See note | 1 | 1 | - | - |
| 2 | 2 | 2 | 1 | 2,048 |
| 3 | 3 | 3 | 2 | 2 × 2,048 |
| 4 | 4 | 4L | 2 | 2 × 2,048 |
| See note | 5 up to 11 | 4H up to 8 | - | - |
| NOTE: These classes are not covered in the present document. | | | | |

**Table F.1b: Minimum RIC and equivalent PDH/SDH capacity for CS = 3,5 MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| 2 (note 1) | 1 | 1 | 1 | 2,048 |
| 4 | 2 | 2 | 2 | 2 × 2,048 |
| 6 | 3 | 3 | 3 | 3 × 2,048 |
| 8 | 4 | 4L | 4 | 8,448 |
| Note 2 | 5 up to 11 | 4H up to 8 | - | - |
| NOTE 1: This class is present only for 50 GHz band.<br>NOTE 2: These classes are not covered in the present document. | | | | |

**Table F.1c: Minimum RIC and equivalent PDH/SDH capacity (CS = 7 MHz)**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| 4 (note 1) | 1 | 1 | 2 | 2 × 2,048 |
| 8 | 2 | 2 | 4 | 8,448 |
| 12 | 3 | 3 | 6 | 6 × 2,048 |
| 16 | 4 | 4L | 8 | 2 × 8,448 |
| 24 | 5 | 4H | 12 | 3 × 8,448 |
| 29 | 6 | 5L | 14 | 14 × 2,048 |
| 34 | 7 | 5H | 16 | 34,368 |
| 39 | 8 | 6L | 21 | STM-0 |
| Note 2 | 9 to 11 | 6H to 8 | - | - |
| NOTE 1: This class is present only for 50 GHz and higher bands.<br>NOTE 2: These classes are not covered in the present document. | | | | |

**Table F.1d: Minimum RIC and equivalent PDH/SDH capacity for CS = ~14 (13,75 to 15) MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| 8 (see note) | 1 | 1 | 4 | 8,448 |
| 16 | 2 | 2 | 8 | 2 × 8,448 |
| 24 | 3 | 3 | 12 | 3 × 8,448 |
| 32 | 4 | 4L | 16 | 34,368 |
| 49 | 5 | 4H | 24 or 21 (if VC12 framed) | 6 × 8,448 or STM-0 |
| 58 | 6 | 5L | 28 | 7 × 8,448 |
| 68 | 7 | 5H | 32 | 2 x 34,368 |
| 78 | 8 | 6L | 40 | 10 × 8,448 |
| 88 | 9 | 6H | 48 or 42 (if VC12 framed) | 3 x 34,368 or 2 x STM-0 |
| 98 | 10 | 7 | 52 | 13 × 8,448 |
| 107 | 11 | 8 | 56 | 14 × 8,448 |
| NOTE: This class is present only for 50 GHz and higher bands. | | | | |

**Table F.1e: Minimum RIC and equivalent PDH/SDH capacity for CS = ~28 (27,5 to 30) MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| 16 (see note) | 1 | 1 | 8 | 2 × 8,448 |
| 32 | 2 | 2 | 16 | 34,368 |
| 48 | 3 | 3 | 24 or 21 (if VC12 framed) | 6 × 8,448 or STM-0 |
| 64 | 4 | 4L | 32 | 2 × 34,368 |
| 98 | 5 | 4H | 48 or 42 (if VC12 framed) | 3 × 34,368 or 2 x STM-0 |
| 117 | 6 | 5L | 56 | 14 × 8,448 |
| 137 | 7 | 5H | 64 or 63 (if VC12 framed) | 4 × 34,368 or STM-1 |
| 156 | 8 | 6L | 80 | 14 × 8,448 |
| 176 | 9 | 6H | 96 or 84 (if VC12 framed) | 6 × 34,368 or 4 x STM-0 |
| 196 | 10 | 7 | 104 | 26 × 8,448 |
| 215 | 11 | 8 | 112 or 106 (if VC12 framed) | 7 × 34,368 or 5 x STM-0 |
| NOTE: This class is present only for 50 GHz and higher bands. | | | | |

**Table F.1f: Minimum RIC and equivalent PDH/SDH capacity for CS = ~56 (55 to 60) MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| 32 (see note) | 1 | 1 | 16 | 34,368 |
| 64 | 2 | 2 | 32 | 2 × 34,368 |
| 96 | 3 | 3 | 48 or 42 (if VC12 framed) | 3 × 34,368 or 2 x STM-0 |
| 128 | 4 | 4L | 64 or 63 (if VC12 framed) | 4 × 34,368 or STM-1 |
| 196 | 5 | 4H | 96 or 84 (if VC12 framed) | 6 × 34,368 or 4 x STM-0 |
| 235 | 6 | 5L | 112 or 105 (if VC12 framed) | 7 × 34,368 or 5 x STM-0 |
| 274 | 7 | 5H | 144 or 126 (if VC12 framed) | 9 × 34,368 or 2 x STM-1 |
| 314 | 8 | 6L | 160 or 147 (if VC12 framed) | 10 × 34,368 or 7 x STM-0 |
| 352 | 9 | 6H | 192 or 168 (if VC12 framed) | 12 × 34,368 or 8 x STM-0 |
| 392 | 10 | 7 | 208 or 189 (if VC12 framed) | 13 × 34,368 or 3 x STM-1 |
| 431 | 11 | 8 | 224 or 210 (if VC12 framed) | 14 × 34,368 or 10 x STM-0 |
| NOTE: This class is present only for 50 GHz and higher bands. | | | | |

**Table F.1g: Minimum RIC and equivalent PDH/SDH capacity for CS = ~112 (110 to 112) MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| See note | 1 | 1 | - | - |
| 128 | 2 | 2 | 64 or 63 (if VC12 framed) | 4 × 34,368 or STM-1 |
| 191 | 3 | 3 | 96 or 84 (if VC12 framed) | 6 × 34,368 or 4 x STM-0 |
| 256 | 4 | 4L | 128 or 126 (if VC12 framed) | 8 × 34,368 or 2 x STM-1 |
| 392 | 5 | 4H | 192 or 168 (if VC12 framed) | 12 × 34,368 or 8 x STM-0 |
| 470 | 6 | 5L | 240 or 210 (if VC12 framed) | 15 × 34,368 or 10 x STM-0 |
| 548 | 7 | 5H | 288 or 252 (if VC12 framed) | 18 × 34,368 or 4 x STM-1 or STM-4 |
| 627 | 8 | 6L | 320 or 294 (if VC12 framed) | 20 × 34,368 or 14 x STM-0 |
| 705 | 9 | 6H | 368 or 336 (if VC12 framed) | 23 × 34,368 or 16 x STM-0 |
| 784 | 10 | 7 | 400 or 378 (if VC12 framed) | 25 × 34,368 or 6 x STM-1 |
| 862 | 11 | 8 | 432 or 420 (if VC12 framed) | 27 × 34,368 or 20 x STM-0 |
| NOTE: This class is not presently covered in the present document. | | | | |

**Table F.1h: Minimum RIC and equivalent PDH/SDH capacity for CS = 40 MHz**

| Minimum applicable RIC (Mbit/s) | Spectral efficiency | | Minimum Equivalent PDH/SDH rates (Mbit/s) | |
|---|---|---|---|---|
| | Reference index | Class | Equivalent number of 2,048 streams | Hierarchical (example) |
| Note 1 | 1 to 5 | 1 to 4H | - | - |
| 137 | 6 | 5L | 80 or 63 (if VC12 framed) | 5 × 34,368 or STM-1 |
| 137 (note 2) | 7 | 5H/28 | 80 or 63 (if VC12 framed) | 5 × 34,368 STM-1 |
| 196 | 7 | 5H | 96 or 84 (if VC12 framed) | 6 × 34,368 or 4 × STM-0 |
| 224 | 8 | 6L | 112 or 105 (if VC12 framed) | 7 × 34,368 or 5 × STM-0 |
| 252 | 9 | 6H | 128 or 126 (if VC12 framed) | 8 × 34,368 or 2 × STM-1 (note 3) |
| 280 | 10 | 7 | 144 or 126 (if VC12 framed) | 9 × 34,368 or 2 × STM-1 (note 3) |
| 308 | 11 | 8 | 160 or 147 (if VC12 framed) | 10 × 34,368 or 7 × STM-0 |

NOTE 1: These classes are not presently covered in the present document.
NOTE 2: This system does not respect the minimum RIC density for their classes; however, it is also considered in the present document for commonality of more widely used technology for bands based on CS = ~28 MHz.
NOTE 3: 4 × STM-1 or STM-4 are possible coupling two systems operating over 2 × 40 MHz channels or two ACCP systems in CCDP operation on different polarization of the same 40 MHz channel.

# F.3 System parameters

There are no essential requirements under the R&TTE Directive [1] specific to the radio systems Network Interface Capacity (NIC) represented by the sum of electrical or optical base-band interface (PDH/SDH, packet data or any other kind of interface) at the reference points X/X' shown in the generic block diagram of figure 1 of EN 302 217-1 [6].

All radio requirements shall be taken from a unique appropriate set of technical parameters defined on the basis of radio frequency band, channel separation, spectral efficiency class and their associated minimum RIC requirement.

When packet data interface are provided, the supplier shall declare the actual Radio Interface Capacity (RIC). In addition, the Network Interface Capacity (NIC) defined at X'/X reference point of figure 1 in EN 302 217-1 [6] shall be equal to or exceed the actual Radio Interface Capacity (RIC) to allow application of a specific set of technical parameters.

## F.3.1 Transmitter

Transmitter requirements and test procedures are independent from the type of data and base-band interfaces.

## F.3.2 Receiver

All requirements for the same channel separation for the same class of equipment are applicable provided that, when packed data interfaces are provided, 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 means (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 Ratio (BER) and Frame Error Ratio (FER)**

| BER | FER |
|---|---|
| $10^{-6}$ | $5 \times 10^{-4}$ |
| $10^{-8}$ | $5 \times 10^{-6}$ |
| $10^{-10}$ | $5 \times 10^{-8}$ |
| $10^{-12}$ | $5 \times 10^{-10}$ |

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.27].

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, within a given channel arrangement, 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 operating frequency sub-ranges (i.e. a number of pre-selectable channels within a given channel arrangement, covered without changing any hardware e.g. duplex filters), it is considered enough that one frequency sub-range is subject of testing.
The test report shall be produced:

   - for transmitter parameters summarized in table 5, for the lowest (B, bottom), intermediate (M, median) and highest (T, top) possible radio frequency channel within that operating frequency range (see figure G.2);

   - for receiver parameters summarized in table 7, only Spurious emissions - external and BER as a function of RSL parameters, for the lowest (B, bottom), intermediate (M, median) and highest (T, top) possible radio frequency channel within that operating frequency range. Other receiver parameters have to be tested for the intermediate radio frequency channel (M) 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: In principle, all tests are carried out on the same equipment during a single test session. However, it is permitted to have different test sessions and equipment under test to allow for unpredictable events (e.g. equipment or test instrument failure during the test session that is not immediately repairable), and for any additional tests required by a future revision of the present document. This allowance is not intended as a means to circumvent 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 figures G.1 and G.2).

- 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).

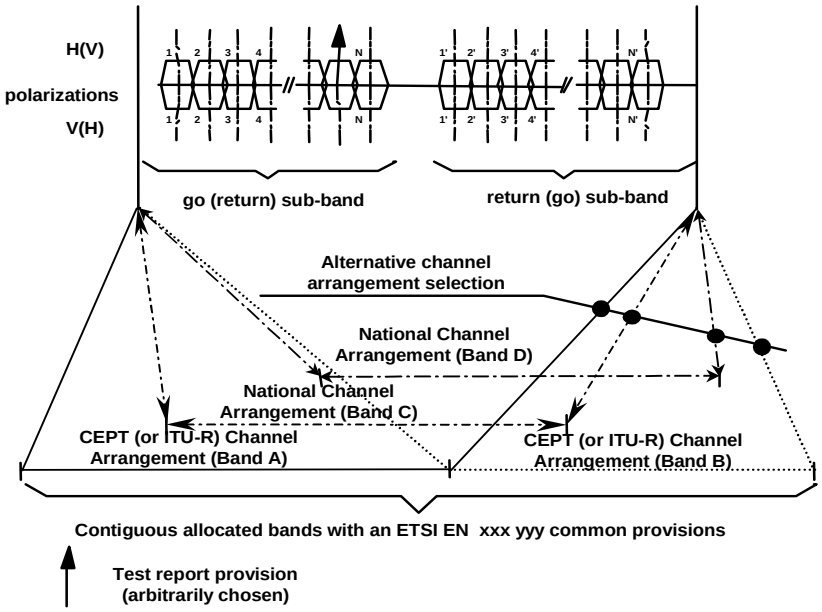



**Figure G.1: Test report frequency requirement for equipments intended for single channel operation**

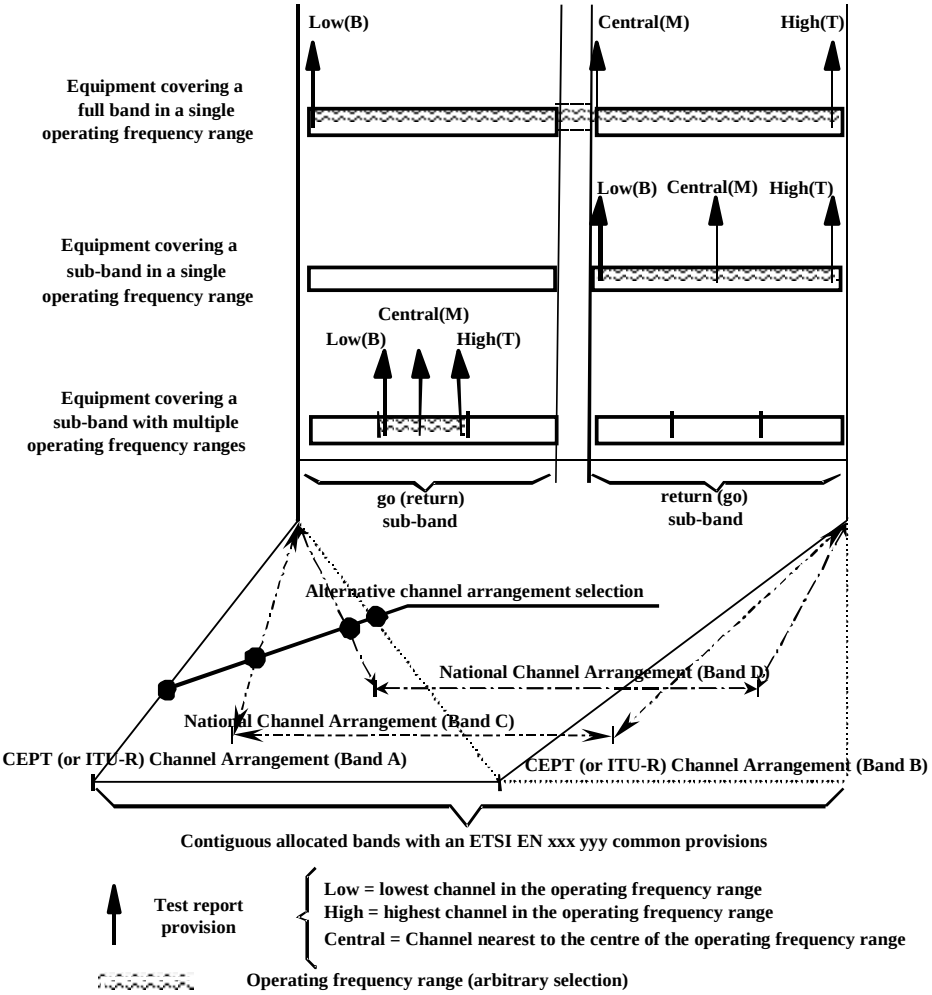



**Figure G.2: Test report frequency requirements for equipments intended for covering an operating frequency range**

# G.2 Multirate/multiformat equipment

DFRS equipments can be designed either for a unique payload and modulation format (*single-mode* systems, see note) or for covering a number of different payload-rates ("*multirate"* systems, see note) 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 CS, the payload and modulation presettings may offer static operation over different payload/modulation (*preset-mode* systems, see note) or dynamic operation changing payload/modulation (*mixed-mode* systems, see note) according network requirements (e.g. propagation variations).

NOTE: As defined in EN 302 217-1 [6].

For *preset-mode* and *mixed-mode* systems the equipment shall comply with all the requirements of the present document at any possible combination of operating RIC, CS and efficiency classes declared (see note in clause G.2.1).

## G.2.1 Generic required tests in the test report

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, at each frequency channel prescribed in clause G.1, for:

- transmitter parameters summarized in table 5 at any possible CS and efficiency classes, each case should be loaded with the highest possible RIC;
- receiver parameters summarized in table 7 shall be tested only at the lowest and the highest CS for any efficiency class, each case loaded with the highest possible RIC.

*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 they were *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/4/16/32/64/128/256/512/1024QAM) in dynamic operations but, for technical/operational convenience only few modes might be available as "*reference*" (e.g. only 4/16/128QAM are considered suitable for network performance and availability needs and/or 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.2.2 Reduced required tests in the test report

*Preset-mode* and *mixed-mode* systems usually use constant, or scalable with CS, baseband processing (e.g. symbol rate, FEC typology/redundancy). This implies, de facto, that the results of many tests are also expected to have the same results scaled for CS and/or baseband processing.

Therefore, for their test report, *Preset-mode* and *mixed-mode* may benefit of a reduced set of required tests as described in following clauses G.2.2.1 and G.2.2.2.

### G.2.2.1 Reduced transmitter tests

When the systems refers only to "unified" masks in clause 4.2.4.2.1, further reduction of *preset-mode* and *mixed-mode* test report complexity is permitted; transmitter parameters test report may be reduced as follows:

a) The lowest and highest efficiency class provided (*preset-mode* systems) or used as *reference-mode* (*mixed-mode* systems) should be tested, only for the lowest and the highest CS, at all three test frequency channels (B, M and T), if applicable.

b) The other modes provided (*preset-mode* systems) or used as *reference-mode* (*mixed-mode* systems), for the all CSs, only at the M frequency channel.
In addition, for these cases, the frequency range of the spurious emission test will be reduced to ±1 GHz or to the frequency band boundaries (whichever results larger) across the M test frequency.

In case one or more preset/reference modes may operate on a CS with more than one *symbol-rate* (e.g. for different error correction coding), the test shall be done with the highest *symbol-rate*.

Figure G.3 graphically show the reduced set of tests.

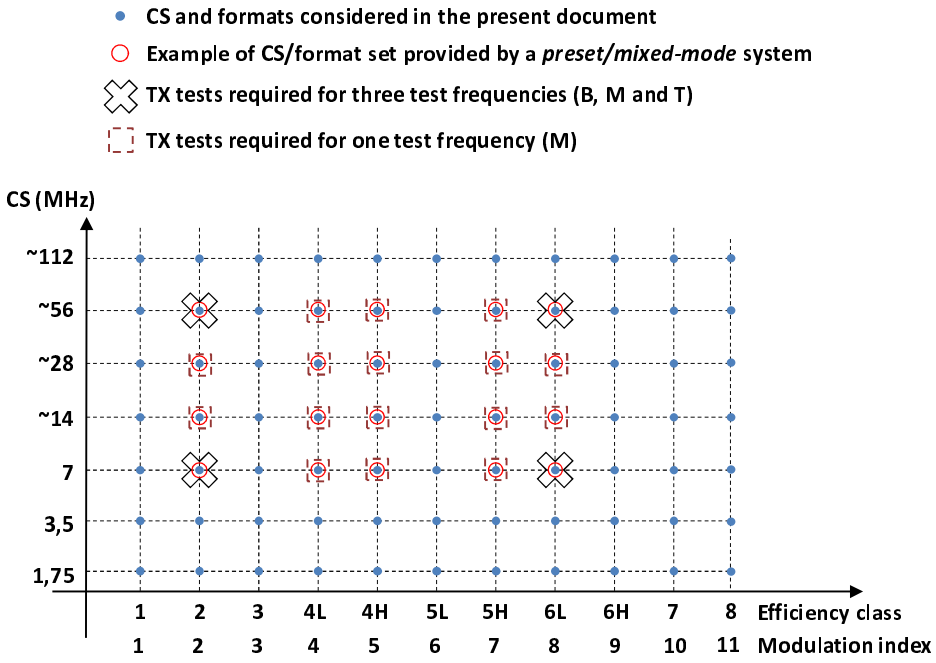



**Figure G.3: Example of *Preset/mixed-mode* systems reduced TX test report**

## G.2.2.2 Reduced receiver tests

As further permitted reduction of *preset-mode* and *mixed-mode* test report complexity, it is considered that receiver parameters can be tested, only for efficiency classes provided (*preset-mode* systems) or used as *reference-mode* (*mixed-mode* systems) as follows:

1) RX BER versus RSL (clause 4.3.2):

   1a) The lowest and highest efficiency class should be tested, only for the relevant lower and the higher CS, at all three test frequency channels (B, M and T).

2) RX spurious emissions (clause 4.3.1) further reduced only to test, at all three test frequency channels (B, M and T), for the lowest and the highest CS with the lowest efficiency class provided for those channels.

3) RX co/adjacent channel interference (clause 4.3.3) and CW spurious interference (clause 4.3.4) further reduced to test:

   3a) At M test frequency channel, with the lowest and highest efficiency class only, for the lowest and the highest CS.

   3b) CW spurious interference should be additionally tested also at M test frequency channel with the highest efficiency class only, for other intermediate CSs. In addition, for these cases, the frequency range of the test will be reduced to ±1 GHz or to the frequency band boundaries (whichever results larger) across the M test frequency.

In case one or more preset/reference modes may operate on a CS with more than one *symbol-rate* (e.g. for different error correction coding), the test shall be done with the highest *symbol-rate*.

Figure G.4 graphically shows the reduced set of tests.

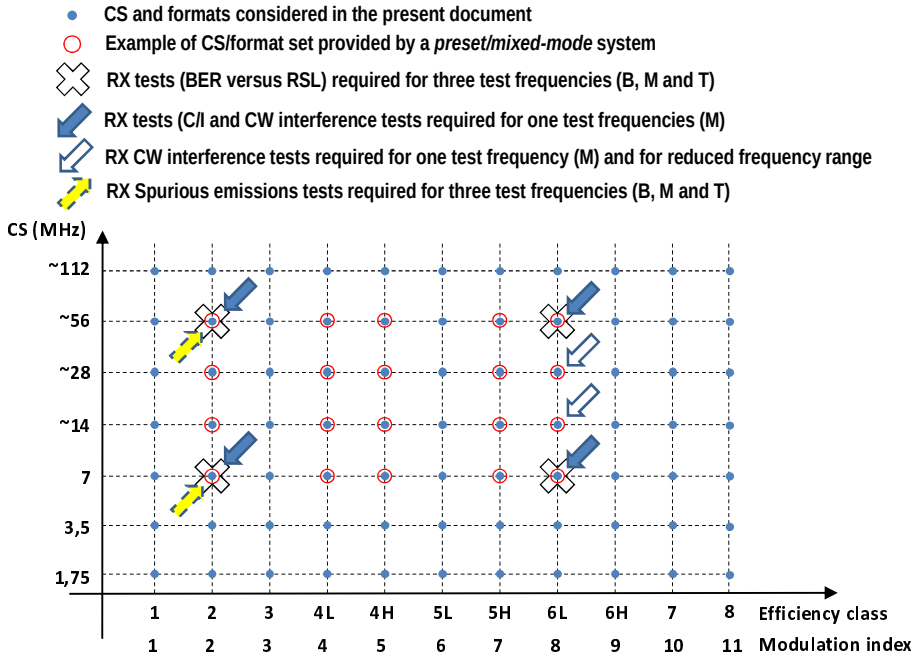



**Figure G.4: Example of *Preset/mixed-mode* systems reduced RX test report**

## G.2.3 Bandwidth adaptive test set requirements

When "*bandwidth adaptive*" operation is considered, the *reference modes* are defined as those relevant to the widest possible bandwidth and therefore tests for R&TTE Directive assessment should be performed according the above clauses G.1 and G.2. There may also be a number of preset operational modes with differing maximum bandwidth; these will be tested as independent CS modes, each with its own "*reference modes*" (see example).

EXAMPLE: A system may adjust its operational mode to not exceed a maximum licensed CS of 500 MHz, dynamically reducing to 250 MHz or even less (or a maximum licensed CS of 1 000 MHz, dynamically reducing to 250 MHz, and so on). These are seen as two different CS operational modes, 500 MHz and 1 000 MHz.

# G.3 BER measurement in a SDH or Ethernet multi-interfaces, multi-channels system

This clause deals with systems that have one or both of the following characteristics:

- SDH (e.g. STM-4 or several STM-1) interfaces, or Ethernet (e.g. 1000BaseT or several 100BaseT) interfaces;
- two RF equipment (e.g. 2 × STM-1 or 300 Mbit/s RIC each) using two channels ("*multi-channel*" operation, on different frequency and/or polarization, see definition in EN 302 217-1 [6]) (note).

In order to keep the requirements set out in the standard aligned with single channel 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.

NOTE: In addition, without any impact on the guidelines of this annex, the emission of each of the two equipment could be composed by one single-carrier or by two or more sub-carriers (*"multi-carrier"* equipment, see definition in EN 302 217-1 [6]).

## G.3.1 Case 1: multi-interfaces/single channel or multi-interfaces/two-channels systems where each interface payload is transmitted on one channel only

This case fits with the examples of transmission of 2 × STM-1 (or 3 × 100BaseT) single channel or 4 × STM-1 (or 6 × 100BaseT) dual channels; each interface is transmitted only over one channel.

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 (or 100BaseT) signal is transmitted by one equipment on one single channel, all measurements of performance are in general identical to other single interface, single channel systems.

## G.3.2 Case 2: single interface/two-channels system

This case fits with the example of transmission of STM-4 (or 1000BaseT) dual channels.

Test equipment will be connected to the STM-4 (or 1000BaseT) 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 channels system**

| Clause | Measurement | Test method | BER requirement |
|---|---|---|---|
| 4.3.2 | BER vs. RSL | Both channels Simultaneously | As specified |
| 4.3.3 and 4.3.4 | External Co-channel and adjacent channel Interference | The same simulated link attenuation should be added to both channels until the $10^{-6}$ threshold, as specified in clause 5.5.1, is reached. The interferer and the 1 dB (3 dB) degradation is applied to one channel only | As specified |

## G.3.3 Case 3: multi-interfaces/two-channels system where each payload interface is transmitted on both channels

This case fits with the examples of transmission of 4 × STM-1 (or 6 × 100BaseT) dual channels; each interface is transmitted over both channels.

Test equipment will be connected to one of the STM-1 (or 1000BaseT) interfaces. The resulting BER shall comply with the requirements in the standard as described in table G.2.

**Table G.2: BER for multi-interfaces/two channels system**

| Clause | Measurement | Test method | BER requirement |
|---|---|---|---|
| 4.3.2 | BER vs. RSL | Both channels Simultaneously | As specified |
| 4.3.3 and 4.3.4 | External Co-channel and adjacent channel Interference | The RSL is set on both channels at the $10^{-6}$ threshold, as specified in clause 5.5.1. The interferer, together with the 1 dB (3 dB) degradation is applied on one channel at a time, on both channels (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 interface, during the two measurements, therefore the BER limits shall be modified accordingly (e.g. twice $5 \times 10^{-7}$ instead of $1 \times 10^{-6}$). For planning purposes, please note that if there is interference on both channels, the resulting BER will be $1 \times 10^{-6}$. | | | |

# 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 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(s);
- it provides a statement of all the test procedures corresponding to those 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**<br>The following requirements and test specifications are relevant to the presumption of conformity under article 3.2 of the R&TTE Directive [1] | | | | | | |
|---|---|---|---|---|---|---|
| **Requirement** | | | **Requirement Conditionality** | | **Test Specification** | |
| **No** | **Description** | **Reference: Clause No** | **U/C** | **Condition** | **E/O** | **Reference: Clause No** |
| 1 | Transmitter power and power tolerance | 4.2.1 | U | | O | 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 | Remote Transmit Power Control (RTPC) (see note 1) | 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 | Void | | | | | |
| 6 | Spectrum mask (see note 1) | 4.2.4 | U | | O | 5.2.4 |
| 7 | Discrete CW components exceeding the spectrum mask limit (see note 1) | 4.2.5 | U | | O | 5.2.5 |
| 8 | Spurious emissions | 4.2.6 | U | | O | 5.2.6 |
| 9 | Transient behaviour of the transmitter - Dynamic change of modulation order | 4.2.7 | C | Only applies to *mixed-mode* systems | E | 5.2.7 |
| 10 | Frequency error/stability – Radio frequency tolerance | 4.2.8 | U | | O | 5.2.8 |

| Harmonized Standard EN 302 217-2-2<br>The following requirements and test specifications are relevant to the presumption of conformity under article 3.2 of the R&TTE Directive [1] | | | | | | |
|---|---|---|---|---|---|---|
| **Requirement** | | | **Requirement Conditionality** | | **Test Specification** | |
| **No** | **Description** | **Reference: Clause No** | **U/C** | **Condition** | **E/O** | **Reference: Clause No** |
| 11 | Off-axis EIRP density - Radiation Pattern Envelope (RPE) | 4.4.1 | C | Only applies to systems with integral antennas | E | 5.4.1 |
| 12 | Antenna gain | 4.4.2 | C | | E | 5.4.2 |
| 13 | Antenna Cross-Polar Discrimination | 4.4.3 | C | | E | 5.4.3 |
| 14 | Spurious emissions | 4.3.1 | U | | O | 5.3.1 |
| 15 | BER as a function of receiver input signal level | 4.3.2 | U | | E | 5.3.2 |
| 16 | Co-channel interference sensitivity | 4.3.3 | U | | E | 5.3.3 |
| 17 | Adjacent channel interference sensitivity | 4.3.3 | U | | E | 5.3.3 |
| 18 | CW Spurious interference (Blocking or desensitization inc. duplex) | 4.3.4 | U | | E | 5.3.4 |
| 19 | Conformance to EN 302 217-3 [7] | See note 2 | C | Only applies to systems complying with annex Ea of the present document in the bands 71 GHz to 76 GHz and 81 GHz to 86 GHz | See note 2 | |
| NOTE 1: These requirements are relevant for ensuring the necessary "*adjacent channel power*" requirement foreseen by EG 201 399 [i.24]. See TR 101 506 [i.30] for details. Annex UC of EN 302 217-3 [7].<br>NOTE 2: See EN 302 217-3 [7] and its annex UC for details. | | | | | | |

**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): Impact of power control (ATPC and/or RTPC), mixed-mode and bandwidth adaptive operation on spectrum mask and link design requirements

## I.0 General Background for, ATPC, RTPC and mixed mode operation

These functionalities have been developed in most fixed radio systems for assisting appropriate network planning and for improving network efficiency and available capacity.

More extensive description of the technical background behind their implementation and use in the network can be found in TR 103 103 [i.35] "Fixed radio systems; Point-to-point equipment; ATPC, RTPC, Adaptive Modulation (Mixed mode) and Bandwidth Adaptive functionalities. Technical background and impact on deployment, link design and coordination".

The following clauses, give information relevant to the impact of those functions on essential parameters defined in the present document as well as on possible and link design and coordination aspects.

## I.1 ATPC and RTPC implementation background

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.

It is important to understand that the total available range of attenuation is, in general, subdivided in two sub-ranges, which, in principle, are independent from any "labelling" as RTPC or ATPC ranges:

- "Initial" Sub-range where the required spectrum mask is still fulfilled.
- "Final" Sub-range where the required spectrum mask is no longer fulfilled.

The ATPC sub-range may be used within two possible scenarios synthesized by table I.1.

**Table I.1: ATPC requirements versus licensing conditions**

| Coordination/licensing conditions | Effect on network | Requirement |
|---|---|---|
| No ATPC is imposed but the user(s), under his (their) responsibility, apply an ATPC reduction in a homogeneous area for general improvement of the interference situation. | Interference impact on performance and availability is still evaluated with power at nominal level (no ATPC attenuation is considered in the coordination process); therefore:<br>• No improvement in the network density.<br>• The user, under his own responsibility, might obtain additional margin against the calculated performance and availability objectives. | No need for fulfilling the spectrum mask (and NFD) in the ATPC range, which can indifferently use "initial" and/or "final" sub-ranges of attenuation. |
| ATPC is imposed as pre-condition of coordination/licensing (note 1) | Interference impact on performance and availability is evaluated with power reduced by an ATPC range; therefore:<br>• Improvement in the network density could be obtained (note 2).<br>• No additional margin against the calculated performance and availability objectives (note 3). | Need for fulfilling the spectrum mask (and NFD) in the assumed ATPC range, which is supposed to remain within "initial" sub-range of attenuation. |
| NOTE 1: The ATPC range is link-by-link dependent, it is usually determined in order to fix the maximum RSL permitted during unfaded periods.<br>NOTE 2: In general the use of ATPC pre-condition is possible for new links in a network; if existing links in already dense networks were coordinated without any ATPC, the possible density improvement might be severely reduced.<br>NOTE 3: However, in principle and if possible and practical, improvement might still be obtained using the residual ATPC attenuation, under operator responsibility. | | |

Therefore, from the point of view of equipment use in the network, the RTPC and ATPC "labelling" of the available attenuation range is, in principle, different for the two cases considered in table I.1; figure I.1 summarizes this aspect (see note).

NOTE: The use of ATPC in the license conditions is foreseen in some countries on national basis; in addition, the implementation of ATPC functionality is left, as an option, to manufacturer choice. Therefore, the ATPC assessment for specific licensing conditions is not retained "essential" for R&TTE Directive [1] point of view. Nevertheless, the supplier is recommended to define the RTPC/ATPC ranges possibly available for that purpose.

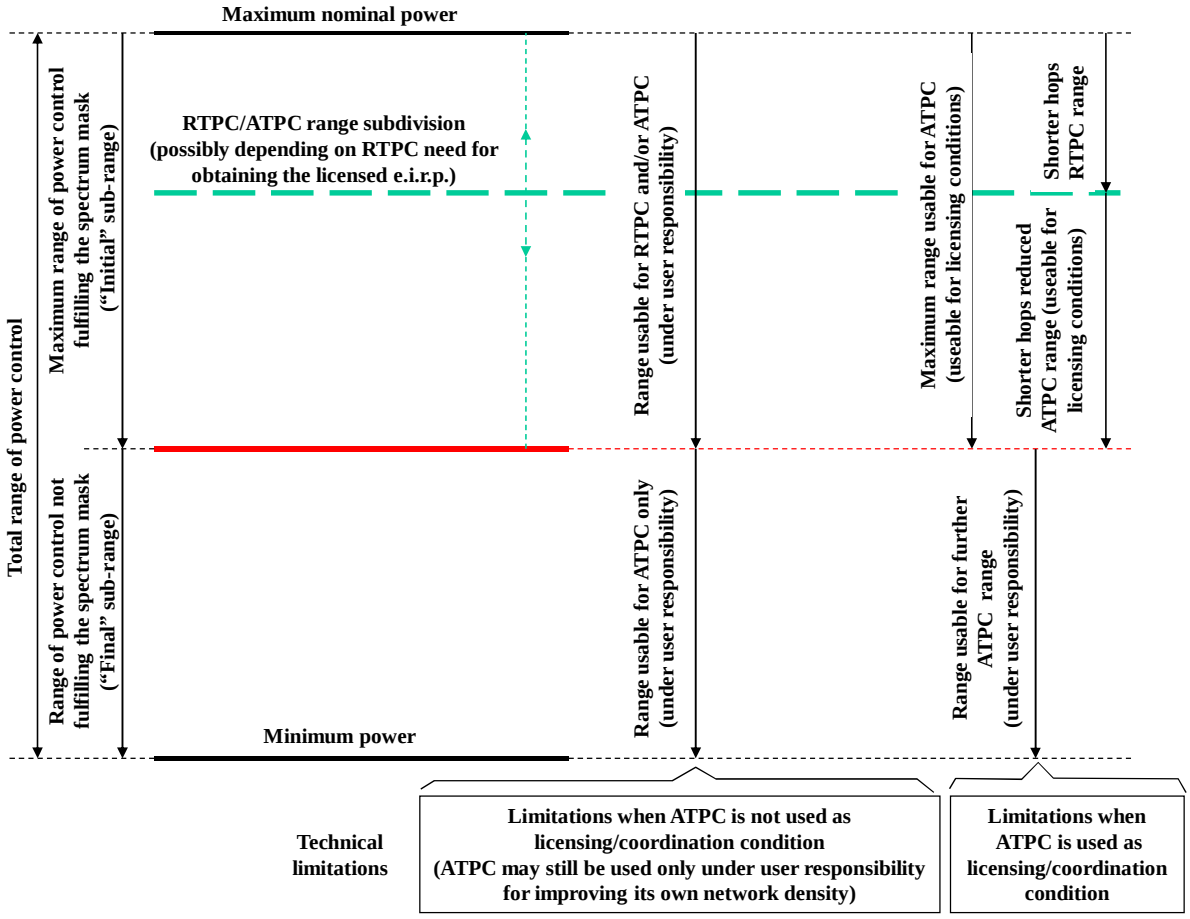



**Figure I.1: ATPC/RTPC ranges and licensing/coordination conditions**

# I.2 Mixed-mode operation impact

## I.2.1 Basic concepts

*Mixed-mode* systems (see note) can dynamically (on the basis of RSL and other built-in quality parameters) smoothly switch between different modulation formats, increasing/decreasing the payload capacity accordingly. At the same time they can manage the TX power output, reducing it for the higher complexity formats that require higher linearity. Therefore, *mixed-mode* systems have also a built-in ATPC functionality.

NOTE: *Mixed-mode* is a notation used in the present document, for commonality with similar concept previously defined for P-MP systems in EN 302 326-2 [i.28]. However, in common point-to-point market practice, these systems are more often identified as "*adaptive modulation*" systems.

*Mixed-mode* technology might be combined with variable (more or less redundant) coding techniques for the same format. In addition, further *bandwidth adaptive* functionality could, in principle, be used (e.g. after reaching the simplest modulation format, the system bandwidth is reduced as described in clause I.3) for further enhancing the link availability for a very limited portion of payload (beyond the minimum modulation format). However; the possible use of this feature is irrelevant for the technical descriptions in this clause.

The variable capacity of the *mixed-mode* systems in various propagation conditions implies that part of the maximum payload is gradually lost. This also requires that mechanism for defining different priority steps to portion of the payloads should be provided and the *mixed-mode* system should be able to detect it in order to gradually eliminate lower priority parts.

# I.3 Bandwidth adaptive operation impact

## I.3.1 Basic concepts

*Bandwidth adaptive* systems can dynamically (on the basis of RSL and other built-in quality parameters) smoothly switch between different bandwidth with the same modulation formats, increasing/decreasing the payload capacity accordingly. In principle, the output power is kept constant because no different linearity requirements are present; therefore, differently from adaptive modulation systems, bandwidth adaptive systems might not have ATPC built-in functions.

These systems are mainly used for high capacity systems in EHF bands (e.g. 70 GHz/80 GHz) where the radio frequency technology does not (yet) permit:

- The use of high level modulation formats (simplest 2 or 4 levels could only be practical until enhanced radio frequency technology might become popular).
- Enough TX power and RX sensitivity for producing a sufficient fade margin for operating the maximum capacity on relatively long hops in geographical areas with sensible rain-rate.

In principle, this technology might be combined with *Mixed-mode* functionality (e.g. switching also between PSK and QPSK). Still in principle, this technology might also be added to (full) adaptive modulation systems described in clause I.2 for further enhancing the link availability for a very limited portion of payload (beyond the minimum modulation format).

## I.3.2 Bandwidth (channel) occupancy

When operated in a network requiring coordination (either under administration or user responsibility) the occupied bandwidth or the channel occupancy (when a channel arrangement is provided) and their relevant system characteristics for coordination (*Reference mode*) should be defined for the maximum bandwidth that will be used for the link under consideration.

# I.4 Impact on frequency co-ordination

However, the possible operative conditions described in detail in TR 103 103 [i.35], which in general implies from time to time the change of modulation format, TX output power and bandwidth, 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 the following 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 nodal 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 [i.20] for "x" dB constant degradation of the noise floor on noise-limited links with suggested values for "x" ranging from 0,2 dB to 3 dB as appropriate) 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 (see figures I.2 and I.3).

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

3) The use of *Mixed mode* over a link coordinated in a specific *Reference mode* may often be considered as "best effort" operation; more information on link design and coordination is found in TR 103 103 [i.35].

4) 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 and, when appropriate, *bandwidth adaptive* systems operations, safely deployed in general coordinated networks, may:

- 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).

- Consider the fact that actual RSL thresholds for "dynamic" transitions among different modes of operation are defined as appropriate, by manufacturer or operators, independently from the "static" RSL of the BER thresholds defined in the present document for the assessment of article 3.2 of the R&TTE Directive [1]. Only the "static" threshold of the *reference mode* is considered relevant for coordination and licensing process; in addition, once activated in "dynamic" operation, this threshold might no longer be reached due to earlier down shift to lower modulation format, see clause 4.3.3 of TR 103 103 [i.35]. In such case, these lower formats could be excluded from dynamic operation, or, when their higher availability is also desired, some "extra margin" on the link for compensating the effect might be recovered by planning the link for an even higher *reference mode* than that initially assumed for matching the desired minimum link capacity with required availability.

- 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 (e.g. as in the 4QAM "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 16QAM "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* 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&TTE Directive [1], see figures I.2 and I.3.

- When *bandwidth adaptive* systems are concerned, be coordinated with their *reference mode* corresponding to maximum bandwidth occupancy and its relevant lowest availability objective.

NOTE: The further possibility during ATPC operation of using the overdrive power conditions (beyond the licensed EIRP for the link), described in clause 4.1.2 of TR 103 103 [i.35], standing its critical applicability, is not considered of general use and, if still desired, is left for specific study by national administrations.

# I.5 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&TTE Directive [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, see also note in clause I.1) has to be 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.

4) *Bandwidth adaptive* systems should be capable of respecting all requirements for the corresponding maximum bandwidth, which will define the "*reference mode*" (or multiple "*reference modes*" when more than one basic licensed channel size may be "*pre-set*" by the equipment.

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&TTE Directive [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.

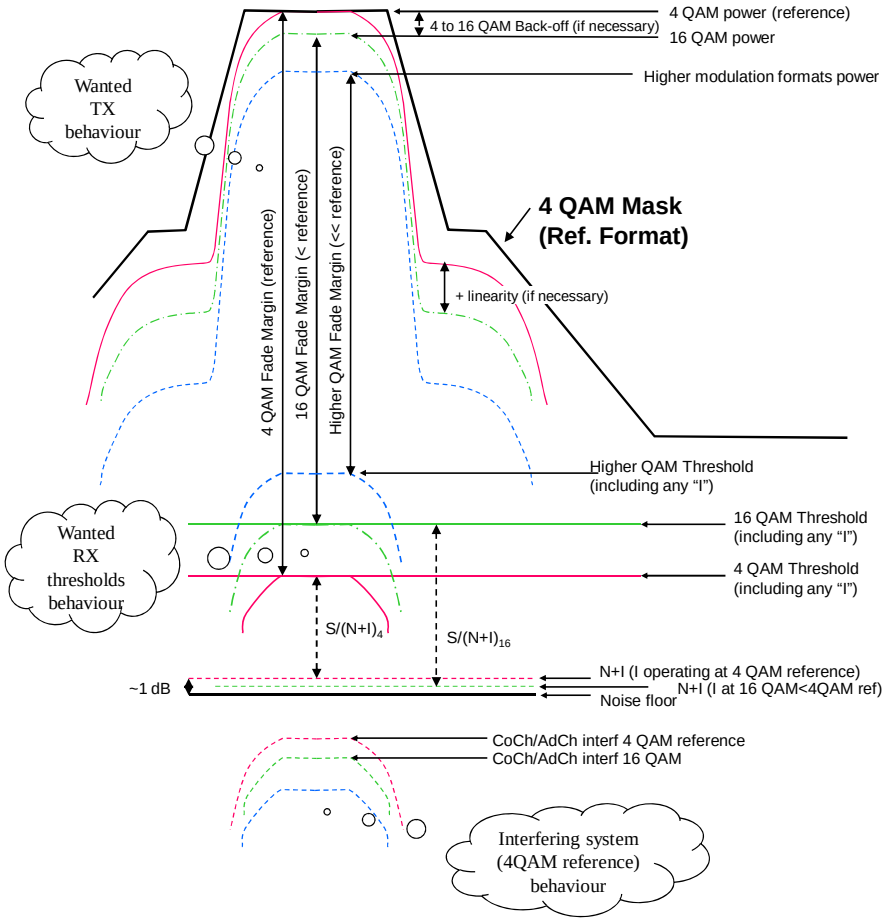



**Figure I.2: Example of nodal co-channel interference (reference modulation format 4QAM):
Delta Fade Margin (dB) = Delta Thr + Back-off**

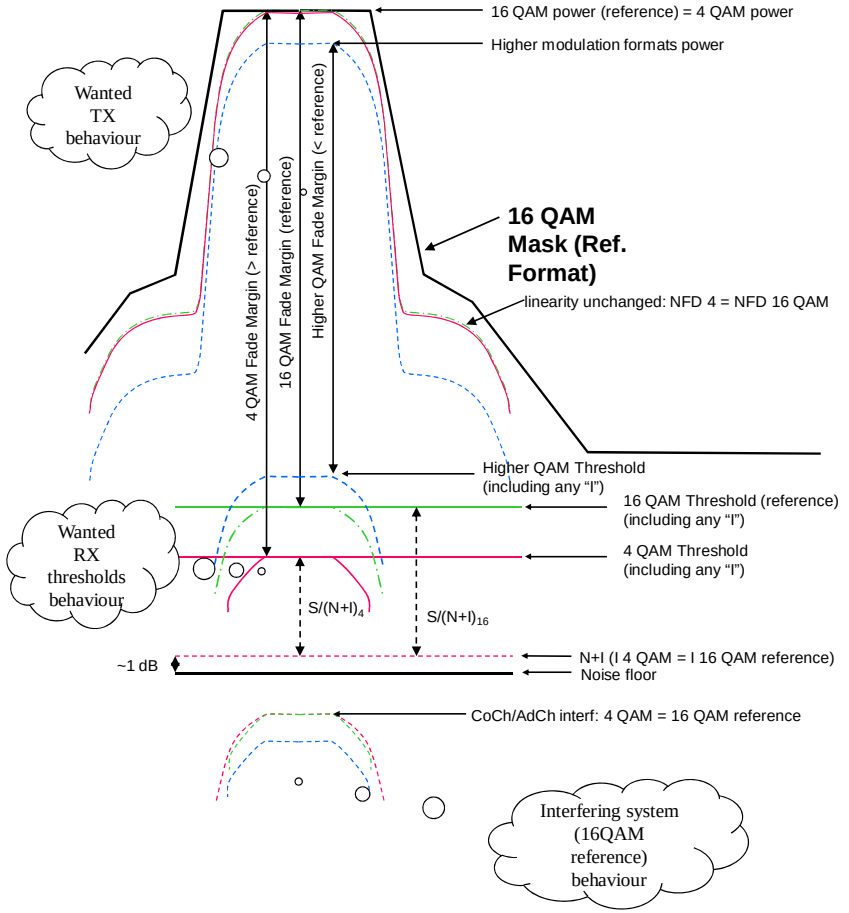



**Figure I.3: Example of nodal co-channel interference (reference modulation format 16QAM):
Delta Fade Margin 4/16 = Delta Thr
Delta Fade Margin 16/HigherQAM = Delta Thr+Back-off**

# 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.

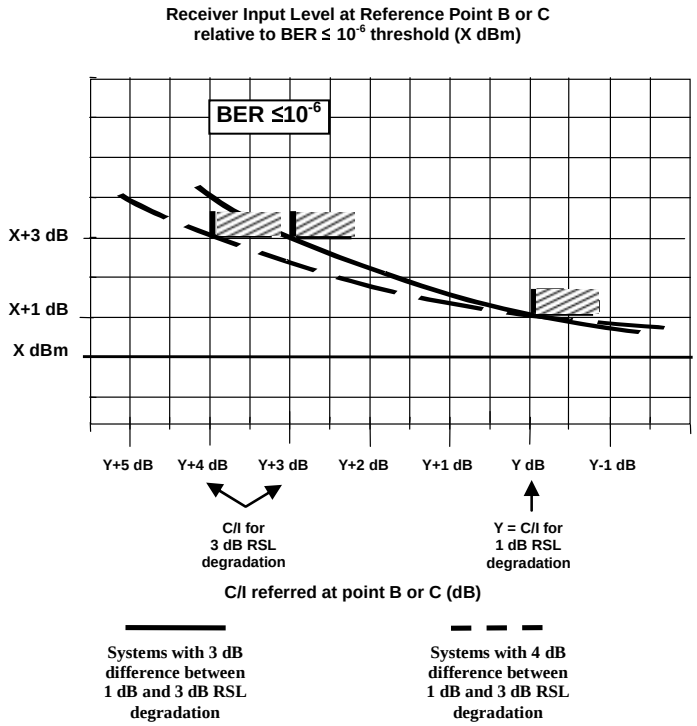



**Figure J.1: Interference threshold degradation versus C/I (typical behaviour)**

# Annex K (informative): 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 302 217-4-1: "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 | | |
| V1.2.3 | September 2007 | Publication | | |
| V1.3.1 | April 2009 | Publication | | |
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