

TSG-RAN Meeting #16
Marco Island, FL, USA, 4 - 7 June 2002

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(ETSI/ERM-RM21(02)MZ_37r1, to TSG-RAN) LS to ETSI TBs involved with radio on draft ECC Recommendations related to OOB, spurious and unwanted emissions

ETSI/ERM-RM21(02)MZ_37r1

European Telecommunications Standards Institute

ERM-RM#21
2nd to 3rd May 2002
Mainz, Germany

Source: ERM-RM
Title: LS to ETSI TBs involved with radio on draft ECC Recommendations related to OOB, spurious and unwanted emissions
Date:

Dear Chairmen,

During its 21st meeting in Mainz, ERM-RM considered two documents received from CEPT/WGSE: one draft ECC Recommendation on unwanted emissions (RM21(02)MZ_16) and one draft revised version of ECC Recommendation 74-01 (RM21(02)MZ_13). These two draft Recommendations, attached to this Liaison Statement, are expected to be sent out for public consultation during the next WGSE meeting in June. However, before this date and during the consultation period (three months), ETSI is invited by WGSE to provide comments and additional information as relevant (for systems not covered by the draft Recommendation; values and masks more stringent in ETSI standards than in the draft ECC/REC;...).

You are invited to provide any possible information to ERM-RM before 2nd September 2002 so that we can forward it to WGSE.

Best regards

Georges de Brito
ERM-RM Chairman

Attachments: RM21(02)MZ_13, RM21(02)MZ_16

European Telecommunications Standards Institute
ERM-RM#21
2nd to 3rd May 2002
Mainz, Germany

Source: ECC-SE
Title: Draft CEPT/ECC/Recommendation UNWANTED
EMISSIONS
Date:
Document for:
Agenda item: 8.4

**Liaison from WGSE to ETSI ERM, ETSI ERM/RM:
Draft CEPT/ECC Rec. UNWANTED EMISSIONS**

Dear M. Wheaton and M. De Brito,

Between 1996 and 2001, ITU-R Study Group 1 has developed and adopted a number of new or revised Recommendations dealing with unwanted emissions. These Recommendations cover spurious and out-of-band (OOB) emissions, the boundary between both domains, intermodulation, OOB falling into adjacent bands and a description of spectra and bandwidth of emission for modern modulation schemes.

The aim of this submitted frame or "roof" recommendation is to give guidance about the use of the whole package of ITU-R Recommendations and their relation to the ERC Recommendation 74-01¹ on unwanted emissions. This Frame Recommendation on Unwanted Emissions does not contain special limits for spurious or OOB domain emissions except for the determination of the boundary between the out-of-band and spurious domains for Radars using the limits given in the ERC Rec 74-01 corresponding to the Category B limits in ITU-R Rec. SM.329-9.

It is the intention of WG SE to approve the "roof" recommendation and the revised ERC Recommendation 74-01 in the next WG SE meeting in Baden, Austria (10 –14 June 02).

Therefore, WG SE would like to invite ETSI/ERM and ERM/RM to consider the attached new draft ECC Recommendation.

Comments to both Recommendations should be sent directly to the responsible Project Team SE 21.
The next meetings of SE21 are scheduled at
26-28 February 2002 in Maisons-Alfort,
27-29 May 2002.

Best regards,

Eric Fournier
WG SE Chairman

Copy : C. Wöste PT SE21 Chairman

Attachment

Draft ECC Rec UNWANTED EMISSION

¹ This Recommendation is under revision by SE21 and was sent to ETSI ERM for consultation.

Draft CEPT/ECC/Recommendation UNWANTED EMISSIONS

Introduction

Between 1996 and 2001, ITU-R Study Group 1 has developed and adopted a number of new or revised Recommendations dealing with unwanted emissions. These Recommendations cover spurious and out-of-band (OOB) emissions, the boundary between both domains, intermodulation, OOB falling into adjacent bands and a description of spectra and bandwidth of emission for modern modulation schemes. Special attention was paid to the protection of Passive and Safety Services from unwanted emissions.

The aim of this frame or "roof" recommendation is to give guidance about the use of the whole package of ITU-R Recommendations and their relation to the ERC Recommendation 74-01 on unwanted emissions. This Frame Recommendation on Unwanted Emissions does not contain special limits for spurious or OOB domain emissions. Fig. 2 illustrates the frame or "roof" concept of this Recommendation.

Unwanted emissions are composed of OOB and spurious emissions as defined in Article S1, No. S1.144-146 of the RR. OOB and spurious emissions as defined there are outside the necessary bandwidth. However, according to Appendix S3 of the RR (WRC-2000) and to ITU-R Rec. SM.329, the spurious domain emission limits are generally applicable for frequency ranges larger than 250 % of the necessary bandwidth. A new terminology, the domain concept, is introduced, the definition of out-of-band and spurious domains which overcomes this aforementioned contradiction. This terminology and the relevant definitions are given ITU-R Rec. SM.329-9 and reproduced in Annex 1 for information and are illustrated in Fig. 1:

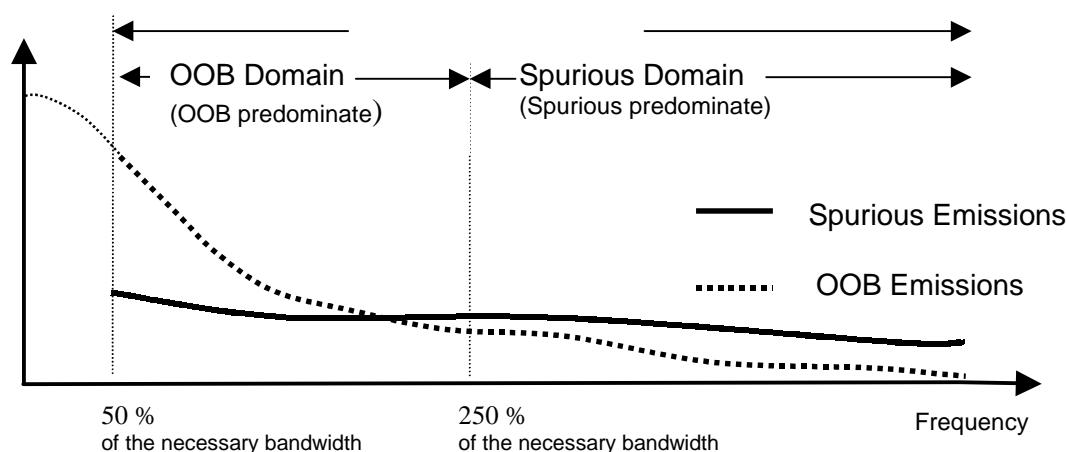


Figure 1: Illustration of the OOB and Spurious Domains (not part of ITU-R Rec. SM.329)

Note: The crossover point between OOB and Spurious emissions is not defined and Fig. 1 shows only an example.

These definitions reflect more exactly the scopes of the ITU-R Rec. SM.329 and Rec. SM.1541, which are all "unwanted emissions in the spurious domain" and "in the out-of-band domain", respectively.

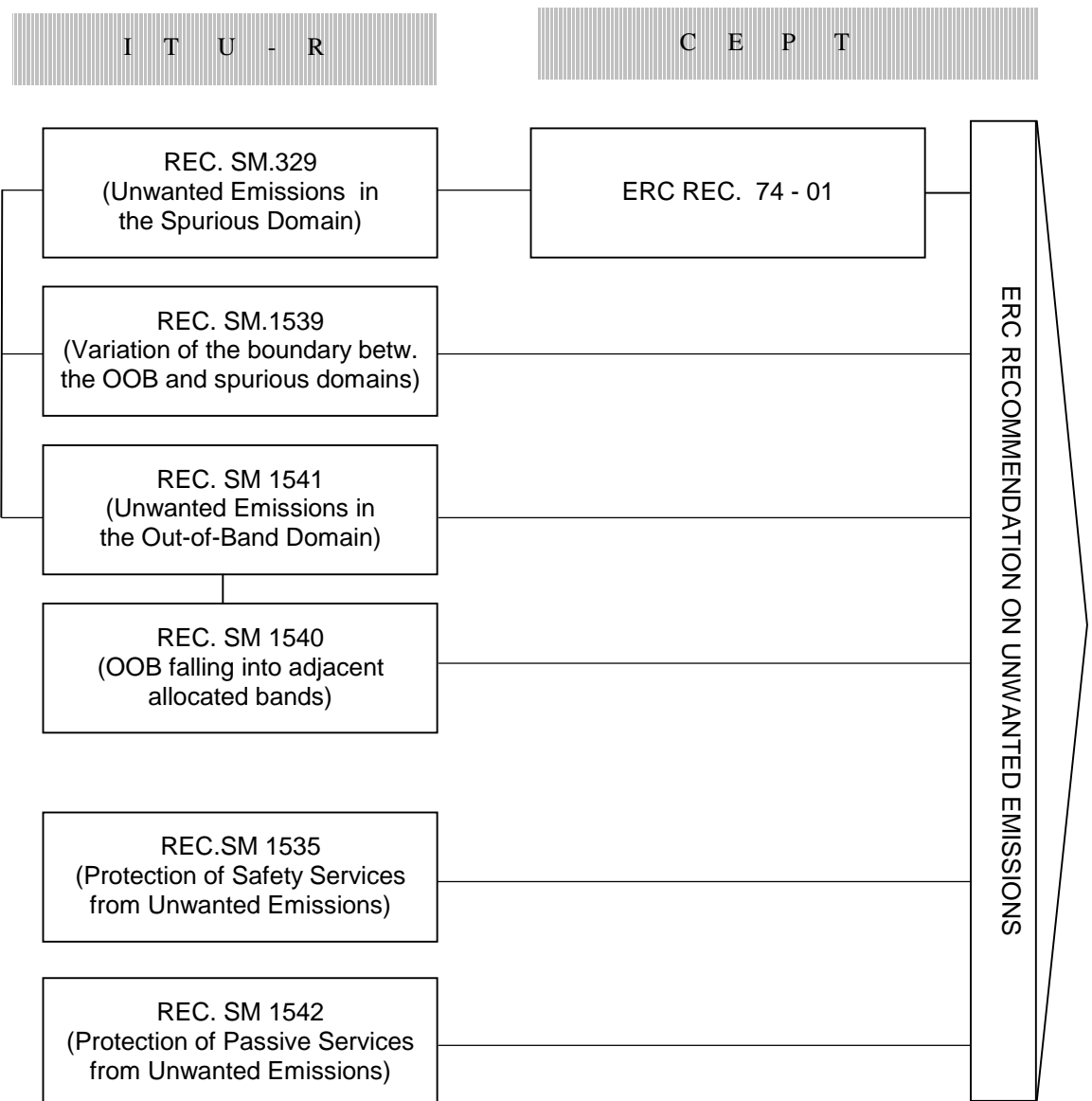


Figure 2: Frame or "roof" structure of this ERC Rec.

"The European Conference on Postal and Telecommunications Administrations,

considering

- a) that the Radio Frequency spectrum is a common resource and it is necessary to keep it as unpolluted as possible, making the best use of the most modern and cost-effective techniques;
- b) that a number of ITU-R Recommendations are available for protection of other radio systems and services from unwanted emissions;
- c) that Recommendation ITU-R SM.329 (Unwanted Emission in the Spurious Domain) relates to effects, measurements, generic and specific regional limits to be applied to unwanted emissions in the spurious domain;
- d) that Recommendation ITU-R SM.1541 (Unwanted Emissions in the Out-of-band Domain) relates to effects, measurements and broadly generic limits to be applied to unwanted emissions in the out-of-band domain;
- e) that the Recommendations ITU-R SM.329 and SM.1541 provides guidance for determining the boundary between the out-of-band and spurious domains in a transmitted radio frequency spectrum;
- f) that Recommendation ITU-R SM.1539 deals with variation of the boundary between the out-of-band and spurious domains required for the application of the Recommendations ITU-R SM.329 and SM.1541;
- g) that Recommendation ITU-R SM.1540 covers unwanted emissions in the out-of-band domain falling into adjacent allocated bands;
- h) that the protection of the Passive Services is covered by Recommendation ITU-R SM.1542;
- i) that the protection of the Safety Services is covered by Recommendation ITU-R SM.1535;
- j) that the Recommendation ITU-R SM.326 deals with intermodulation products generated in amplitude-modulated radio transmitters;
- k) that the Recommendation ITU-R SM.1446 deals with definition and measurement of intermodulation products in transmitters using frequency, phase or complex modulation techniques and related background information and mitigation techniques are provided in the ITU-R Report SM.2021;
- l) that Recommendation ITU-R SM.328 gives definitions and explanatory notes which should be used when dealing with spectra and bandwidth of emissions;

recommends

1. that the ITU-R Recommendations on unwanted emissions should be used as general guidance;
2. that the limits for the unwanted emission in the spurious domain (spurious domain emission limits) should be according to the ERC Recommendation 74-01 that corresponds to the Category B limits in ITU-R Rec. SM.329 and has been derived taking into account ETSI standards;
3. that the limits for the unwanted emission in the out-of-band domain (out-of-band domain emission limits) should be intended as generic limits, which generally constitute the least restrictive out-of-band domain emission limits successfully used in national or regional regulations², and that they are covering all limits provided by ETSI standards, where, in general, more stringent or at least equal limits are given [and should be met]³;
4. that the variation of the boundary between out-of-band and spurious domains should be according those generally covered by ITU-R Rec. SM.1539 except the boundary for Radar systems designed for Category B spurious domain emission limits, for which guidance is provided in Annex 2;
5. that ITU-R Rec SM.1535 and SM.1542 should be used for generic mitigation techniques for reduction of unwanted emissions.

² This concept has been introduced as the "safety net limits" in ITU-R Rec. SM.1541.

³ [Editor's note: There could be a lack for a recommendation from CEPT that ETSI standards should be used for OOB. ETSI masks are part of "voluntary" standards and with this addition would become CEPT recommended but it is not sure if that is the CEPT intention.]

ANNEX 1 (informative)

TERMINOLOGY AND DEFINITIONS USED IN ITU-R REC. SM.329

The following terms and definitions complement those already defined in the Radio Regulations (RR). (Definitions shown in *italics* are a direct quotation from the RR.)

1 Spurious emission (Article S1, No. S1.145 of the RR)

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

1.1 Harmonic emissions

Spurious emissions at frequencies which are whole multiples of the centre frequency emissions.

1.2 Parasitic emissions

Spurious emissions, accidentally generated at frequencies which are independent both of the carrier or characteristic frequency of an emission and of frequencies of oscillations resulting from the generation of the carrier or characteristic frequency.

1.3 Intermodulation products

Spurious intermodulation products result from intermodulation between:

- the oscillations at the carrier, characteristic, or harmonic frequencies of an emission, or the oscillations resulting from the generation of the carrier or characteristic frequency; and
- oscillations of the same nature, of one or several other emissions, originating from the same transmitting system or from other transmitters⁴ or transmitting systems.

1.4 Frequency conversion products

Spurious emissions, not including harmonic emissions, at the frequencies, or whole multiples thereof, or sums and differences of multiples thereof, of any oscillations generated to produce the carrier or characteristic frequency of an emission.

2 Out-of-band emission (Article S1, No. S1.144 of the RR)

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

3 Unwanted emissions (Article S1, No. S1.146 of the RR)

Consist of spurious emissions and out-of-band emissions.

⁴ Signals coupled through the antenna radiation system.

4 Out-of-band and Spurious domains

The terms "out-of-band domain" and "spurious domain" have been introduced in order to remove some inconsistency between, on one hand, the definitions of the terms "out-of-band emission" and "spurious emission" in Article S1 of the Radio Regulations and, on the other hand, the actual use of these terms in Appendix S3 of the Radio Regulations, as revised by WRC-2000. Out-of-band and spurious domain emission limits apply, respectively, to all unwanted emissions in the out-of-band and spurious domains.

4.1 Out-of-band domain

(of an emission): The frequency range, immediately outside the necessary bandwidth but excluding the *spurious domain*, in which *out-of-band emissions* generally predominate.

4.2 Spurious domain

(of an emission): The frequency range beyond the *out-of-band domain* in which *spurious emissions* generally predominate.

NOTE – Out-of-band *emissions*, defined based on their source, occur in the out-of-band domain and, to a lesser extent, in the spurious domain. Spurious emissions likewise may occur in the out-of-band domain as well as in the spurious domain.

5 Necessary bandwidth (Article S1, No. S1.152 of the RR)

For a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

For application to multi-channel or multi-carrier transmitters/transponders, where several carriers may be transmitted simultaneously from a final output amplifier or an active antenna, the necessary bandwidth is taken to be the transmitter or transponder bandwidth, as its 3 dB bandwidth. This does not apply to base stations in the mobile service or to fixed wireless access base stations using mobile technology.

For fixed service, Recommendation ITU-R F.1191 is to be used to calculate the necessary bandwidth in the case of fixed digital radio multi-carrier systems.

For the radiodetermination service, the necessary bandwidth of frequency-agile radars is taken to be the part of the allocated band over which the carrier frequencies of those radars tune.

ANNEX 2

BOUNDARY AND LIMITS FOR PRIMARY RADAR

This Annex defines limits for unwanted emissions in the out-of-band domain for fixed radar stations for which ERC Rec. 74-01 applies the more stringent Category B Limits of ITU-R Recommendation SM.329. By providing these limits the boundary between the out of band domain and the spurious domain is defined.

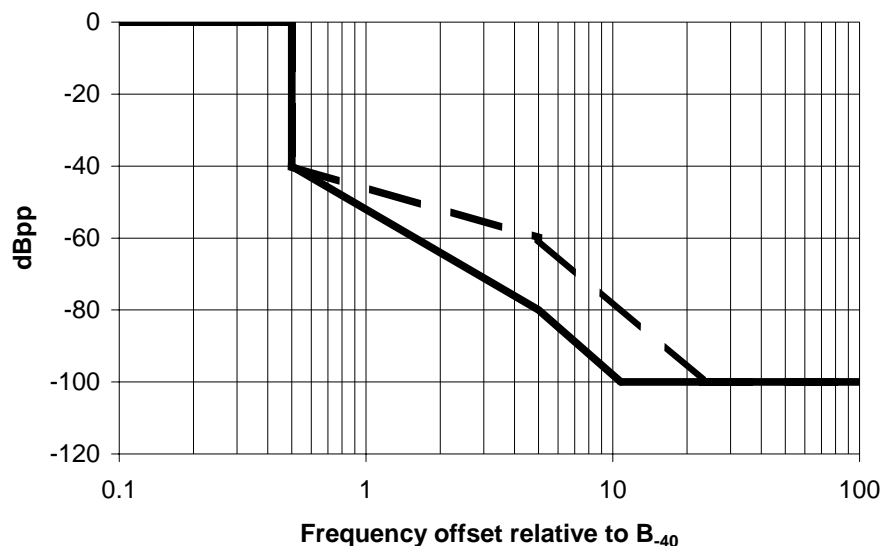
The limits of unwanted emissions in the out-of-band domain for any other radar systems are given in Annex 8 of ITU-R SM.1541.

Two spectrum masks are given, one based on the roll-off of 20 dB/decade and one based on the design objective both taken from the Rec. ITU-R SM.1541. The mask based on an initial 20 dB roll off is applicable to all Radars which fall under this Annex. New radar design should aim to meet the design objectives as soon as possible. In the future it is intended to apply a more stringent mask based upon the design objective.

The two masks are as shown in Figure 1 below.

Figure 1: Emission Mask for Radars

The dashed line is the limit for unwanted emissions in the out of band domain. The solid line represents the proposed design objective.



For the Category B limit the mask rolls off at 20dB per decade from the calculated 40 dB Bandwidth (B_{-40}) to a level of -60 dB_{pp}. The limit continues to roll off at 60 dB per decade to the -100 dB level. For the design aim the mask rolls off at 40dB per decade from the calculated 40dB Bandwidth to a level of -80 dB_{pp}. The limit continues to roll off at 60 dB per decade to the -100 dB level. The equations for determining the 40 dB bandwidth are given in Annex 8 of ITU-R SM.1541.

The limit will result in the out of band emission domain of 46.4 times B_{-40} . The design objective will reduce the out of band emission domain to 21.5 times B_{-40} .

These two masks have the characteristics listed in the following Tables. The limits are given as a multiple of the frequency of the 40 dB bandwidth excursion.

Table 1: Limit of unwanted emission.

Offset Frequency x B_{-40}	Limit dB	Slope dB/decade
0 to 0.5	0	0
0.5	40	∞
0.5 to 5	40 to 60	20
5 to 23.2	60 to 100	60
23.2 to ∞	100	0

Table 2: Design Objective

Offset Frequency x B_{-40}	Limit dB	Slope dB/decade
0 to 0.5	0	0
0.5	40	∞
0.5 to 5	40 to 80	40
5 to 10.75	80 to 100	60
10.75 to ∞	100	0

European Telecommunications Standards Institute

ERM-RM#21

2nd to 3rd May 2002

Mainz, Germany

Source: ECC-SE
Title: LS to ETSI ERM on ECC/REC 74-01
Date:
Document for:
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30th WG SE MEETING
Bunratty, 1-5 October 2001

Doc. SE(01)TEMP41

Date : 2nd October 2001

Subject : **Liaison to ETSI ERM:**
Revision of ERC Recommendation 74-01 on spurious emission

Dear Olly,

The ERC Rec 74-01 contains the European limits and definitions for spurious emissions and corresponds to ITU-R Rec SM.329 which was revised in 2000 by ITU-R SG1 and is now finally approved (Administrative Circular CACE/222). Consequently, the ERC Rec 74-01 is being revised within the SE Project Team 21.

The main modifications are related to :

- the introduction of a new terminology for unwanted emissions occurring in the out-of-band and spurious domains to overcome some possible misunderstandings in Article S1 and Appendix S3 of the Radio regulations,
- the update of ERC Rec 74-01 with the outcome of the recent WRC-2000 and the Rec SM.329-9 and SM.1539
- some specific comments to Fixed Service and Radar.

It should be emphasised that there are no substantial changes in the limits.

Following to the CEPT ETSI MoU, a regular review in the light of the changing technologies and regulatory requirements with a period of 3 years was agreed and stated in the Foreword of this ERC Rec 74-01, that means 2002.

Therefore, WG SE would like to invite ETSI/ERM to consider the attached draft revision of the ERC Recommendation.

It is envisaged to complete the revision of ERC Rec 74-01 together with a new "frame" Recommendation dealing with the relation of all effects of unwanted emission in the early next year. In order to accelerate this process, all comments and suggestions from ETSI/ERM should be directly directed to PT SE21.

The next meetings of SE21 are scheduled at
23-25 October 2001 in Brest,
4-6 December 2001 in Copenhagen and
26-28 February 2002.

Contact point :

Mr Christoph Wöste, SE21 Chairman
RegTP
Canisiusstrasse 21
D-55122 MAINZ (Germany)

Tel: +49 6131 18 3429
Fax: +49 6131 18 5629

Email : christoph.woeste@regtp.de

Kind Regards

Eric Fournier

WGSE Chairman

Draft Revision of CEPT/ERC/RECOMMENDATION 74-01E (Siófok 1998, Nice 1999)**SPURIOUS EMISSIONS¹**

Recommendation proposed by the Working Group "Spectrum Engineering" (WGSE)

Text of the Recommendation adopted by the "European Radiocommunications Committee" (ERC):

Foreword

This Recommendation specifies the limits of the unwanted~~spurious~~ emission ~~limits~~in the spurious domain (spurious limits) for different services and types of equipment. It should be used as a generic guide when drafting new, and revising ETSI standards, and also for guidance to administrations in the absence of relevant standards. It should not be used as a stand-alone document for the purpose of type approval.

It is recognised that certain existing ETSI standards and a limited number of those in an advanced stage of preparation do not fully align with this Recommendation. Where, for historical reasons, such existing standards do not align with this Recommendation, the spurious ~~emission~~ limits should be reviewed if revisions are considered. It is also recognised that, largely as a consequence of new technologies emerging, it may be acceptable that specific standards adopt limits which differ from this Recommendation; these are listed in **Annex 8**.

Where a difference between the limits for a particular standard and this Recommendation might exist, the limits should be agreed following the iterative, consultative procedure given in the ETSI/ERC Memorandum of Understanding¹ (ref. ETSI Collective Letter no. 866 of 26 Jan. 94~~2~~). This procedure should consider the interaction between technical parameters, spectrum efficiency, regulatory and economic aspects.

Where there is a difference between the limits for a particular standard and this recommendation CEPT assumes the following procedure would be useful:

- The relevant technical bodies in ETSI² and CEPT³ will agree to exchange liaison statements to each other whenever they believe changes to this recommendation, an ETSI standard, or the inclusion of a standard into **Annex 8** is required;
- The ETSI liaison statement should be supported by appropriate technical justification and other relevant information. This should include information on economic and market related issues concerning the proposal. In addition ETSI should also provide any information on system spectrum efficiency that they may have available to support their case;
- The CEPT liaison statement should include the implications of the proposal on spectrum engineering parameters such as: effective use of the spectrum, requirements of existing services, sharing/adjacent band and other regulatory issues;
- The proposal should be considered in the spirit of the CEPT/ETSI MoU with dialogue, full consultation and an iterative process if necessary. Ideally this process should be completed within 6 months;

[1 Note – The scope of this Recommendation is more exactly "unwanted emissions in the spurious domain", since the limits also apply to any out-of-band emissions in the spurious domain, but do not apply to spurious emissions in the out-of-band domain.](#)

¹ This is available from the ERO (many ERO documents are available on the ERO web site <http://www.ero.dk>).

² Currently ETSI WG ERM-RM (or ETSI TC ERM).

³ Currently CEPT WG SE.

- The conclusions should be mutually acceptable and neither party should feel that its views have been disregarded;
- When consensus is achieved the results should be recorded in a revision of this recommendation or revision of the appropriate standard.

It is considered appropriate that this Recommendation should be reviewed every three years, in the light of changing technologies and regulatory requirements. This review should involve consultation with the relevant technical and working groups within CEPT and ETSI.

"The European Conference of Postal and Telecommunications Administrations,

considering

- a) that the ~~r~~Radio ~~f~~Frequency spectrum is a common resource and it is necessary to keep it as un-polluted as possible, making the best use of the most modern and cost-effective techniques;
- b) that it is important for CEPT countries to define common limits of unwanted spurious emissions in the spurious domain for all services that may be placed in operation ;
- c) that detailed and specific sharing or compatibility studies may lead to different limits and definitions for the unwanted spurious emissions in the spurious domain from the systems concerned; however these are not in the scope of this recommendation which aims to provide a specific minimum requirement;
- d) that ITU-R Recommendation SM.329 provides options for different categories of limits for unwanted emissions in the spurious domain ~~emissions~~; moreover it provides some degree of freedom to Administrations, for the defined frequency boundaries for the definition of spurious ~~emissions~~ domain and the detailed transition of the limits nearby the fundamental emission; in particular it allows, for digital modulations, definitions, for spurious emissions frequency boundaries, ~~other than the specific $\pm 250\%$ of the Necessary Bandwidth from the centre frequency of the emission~~; however it gives allowance for different definitions when practical;
- e) that ITU-R Recommendation SM.1539 deals with variation of the boundary between the out-of-band and spurious domains, other than the specific $\pm 250\%$ of the Necessary Bandwidth from the centre frequency of the emission;
- e)f) that a revised appendix S3 has been approved at WRC'97, containing new limits mandatory from 2003;
- f)g) that the Radioastronomy Service, the Earth Exploration Satellite Service and the Meteorological Satellite Service using passive sensors are particularly sensitive to interference due to their wide frequency coverage and the weakness of the signals they detect. These limits are far lower than the spurious ~~emission~~ limits considered practicable at the antenna port of most transmitters, therefore the protection of these services depends on additional mitigating factors such as antenna decoupling and spatial separation;
- g)h) that there may be cases where a permanent source of interference, for example a radar or broadcast transmitter in the near vicinity, or spurious emissions generated at the radio transmitter site due to the interaction amongst various transmitters operating at the same time, cause unacceptable performance degradation to a victim receiver. These cases are considered site engineering problems and are not in the scope of this ~~r~~Recommendation provided that it is possible to use special protection applied to either the source of interference, or the victim, or both;
- h)i) that CEPT and ETSI have developed a Memorandum of Understanding describing the relative responsibilities of the two bodies. The MoU text is available from the ERO;
- i)j) that within CEPT/ERC, a statistical simulation methodology based on the 'Monte Carlo' method has been developed and accepted as the basis for the future development of a software tool to enable the assessment of the effect of spurious limits in terms of probability of interference. The tool developed for ERC

will be made available under the conditions of the MoU on development of the Monte Carlo simulation tool. The text of this MoU is available from the ERO;

~~j)k)~~ that ~~unwanted Spurious e~~Emissions may be delivered to the antenna port with consequent radiation from the antenna or produced by direct unwanted radiation from the system enclosure, due to insufficient shielding; however the latter effect is outside the scope of this ~~r~~Recommendation;

~~k)l)~~ that fast switching transients of burst transmission systems may produce specific spurious emission patterns with high peak factor, which may affect victim receivers more severely than that due only to the spurious emissions associated with the average power during the burst duration;

~~h)m)~~ that transmission systems may be coupled to an “Active Antenna System” which may further contribute to generate spurious emissions;

Note: an “Active Antenna System” (AAS) is an antenna with embedded capability for electronic amplification and/or other RF processing. The total gain of an AAS may be functionally split into an “active” gain of the electronic functions (AG) and a conventional “passive” gain/loss (directivity) due to the geometrical design performance of the antenna (PG).

~~n) m)~~ that receivers may also radiate spurious components from the antenna, which are presently not covered by ITU-R Recommendation SM.329;

recommends

1. that ~~spurious emission~~ limits of unwanted emissions in the spurious domain apply at frequencies above and below the fundamental transmitting frequency but separated from the centre frequency of the emission by 250% of the necessary bandwidth. However, this frequency separation may be dependent on the type of modulation used, the maximum bit rate in the case of digital modulation, the type of transmitter, and frequency coordination factors. For example, where practical the $\pm 250\%$ of the relevant Channel Separation (CS) may be used.

Note 1: According to the Radio Regulations, the ~~n~~Necessary ~~b~~Bandwidth is, for a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions. However, the necessary bandwidths of most digital modulation formats are presently not referred to in ITU-R Recommendations of SM series.

Note 2: Considering the flexibility allowed by ITU-R Recommendation SM.329 on the 250% boundary definition, it is recognised that this figure may be appropriate for medium-band systems, while the physical constraint of filtering in narrow-band systems and the resulting amount of spectrum polluted by wide-band systems may require further adaptation (e.g. by a wider or a reduced percentage, respectively), ~~however this will require further study; therefore the 250% figure for narrow band and wide band systems is considered provisional~~ ITU-R Recommendation SM.1539 gives guidance on the boundary variation in these cases.

Note 3: In ITU-R Recommendation SM.329 the spurious domain (of an emission) is defined by the frequency range, beyond the out-of-band domain, in which spurious emission generally dominate.

2. that for the purpose of this ~~r~~Recommendation, only ~~unwanted Spurious e~~Emissions in the spurious domain conducted to the antenna port or subsequently radiated by any integral antenna, are subject to the required limits;

3. that the spurious limits ~~on spurious emissions~~ for radio equipments are considered here to be applicable to the range 9 kHz to 300 GHz. However, for practical measurement purposes only, the frequency range of spurious emissions may be restricted. As guidance for practical purposes, the following measurement parameters are normally recommended:

Fundamental frequency range	Spurious f frequency range for measurements range	
	lower frequency	upper frequency (The test should include the entire harmonic band and not be truncated at the precise upper frequency limit stated)
9 kHz - 100 MHz	9 kHz	1 GHz
100 MHz - 300 MHz	9 kHz	10 th harmonic
300 MHz - 600 MHz	30 MHz	3 GHz
600 MHz - 5.2 GHz	30 MHz	5 th harmonic
5.2 GHz - 13 GHz	30 MHz	26 GHz
13 GHz - 150 GHz	30 MHz	2 nd harmonic
150 GHz - 300 GHz	30 MHz	300 GHz

These parameters reflect the increasing difficulty in undertaking practicable tests, especially at frequencies approaching or beyond 110 GHz, taking into account such factors as availability and usability of suitable measurement equipment. In some circumstances, it may be necessary to extend the range of test frequencies in order to facilitate better protection of other services such as Radioastronomy. In any case, systems having an integral antenna incorporating a waveguide section, or with an antenna connection in such form, and of length equal to at least twice the cut-off wavelength, should not require spurious emissions measurement below 0.7 times the waveguide cut-off frequency;

Note: Further simplifications of measuring techniques to achieve time/cost savings, while still guaranteeing the fulfilment of the requirement, are outside the scope of this Recommendation, but may be taken from the relevant system ETS-EN or Conformance Test Standards when available.

4. that the following reference bandwidths should ~~are to~~ be used:

- 1 kHz between 9 and 150 kHz
- 10 kHz between 150 kHz and 30 MHz
- 100 kHz between 30 MHz and 1 GHz
- 1 MHz above 1 GHz

Note 1: A reference bandwidth is a bandwidth in which the spurious domain emission level is specified.

Note 2: Some services may use, close to the carrier, reference bandwidth values different from the above; these differences are quoted in the relevant service Annex.

As a special case, the reference bandwidth of all space stations' spurious domain emissions should be 4 kHz.

The reference bandwidths required for proper measurement of radar spurious domain emissions ~~should~~ **must** be calculated for each particular radar system, and the measurement methods should be guided by Recommendation ITU-R M.1177. ~~Thus, for the three general types of radar pulse modulation utilised for radionavigation, radiolocation, acquisition, tracking and other radiodetermination functions, the reference bandwidth values in MHz should be:~~

~~A) — for fixed frequency or non-pulse coded radar, the reciprocal of the radar pulse length in microseconds (e.g. if the radar pulse length is 1 microsecond, then the reference bandwidth is $1/1\mu\text{s} = 1\text{ MHz}$);~~

~~B) — for fixed frequency, phase-coded pulsed radar, the reciprocal of the phase chip length in microseconds (e.g. if the phase-coded chip is 2 microseconds long, then the reference bandwidth is $1/2\mu\text{s} = 0.5\text{ MHz}$);~~

~~C) — for Frequency Modulated (FM) or chirped radar, the square root of the quantity obtained by dividing the swept frequency range in MHz by the pulse length, in microseconds (e.g. if the swept frequency range is from 1250 to 1280 MHz or 30 MHz during the pulse of 10 microseconds, then the reference bandwidth is $(30\text{ MHz} / 10\mu\text{s})^{1/2} = 1.73\text{ MHz}$).~~

As a general rule, the resolution bandwidth of the measuring receiver should be equal to the reference bandwidth as given in this recommendation. To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth can be different from the reference bandwidth. When the resolution bandwidth is smaller than the reference bandwidth, the result should be integrated over the reference bandwidth. When the resolution bandwidth is greater than the reference bandwidth, the result for broadband spurious emissions should be normalised to the bandwidth ratio. For discrete spurious, normalisation is not applicable, while integration over the reference bandwidth is still applicable;

5. that the levels of spurious domain emissions should be defined within a reference bandwidth;
6. that the appropriate spurious ~~emissions~~ limit is to be applicable to all services as detailed by **Table 1**. Unless PEP is explicitly quoted the spurious ~~emission~~ limits, quoted in **Table 1**, from the transmitter into the antenna port are in terms of mean power. The mean power (P) of any spurious domain transmission from a burst transmitter is the mean power averaged over the burst duration.

Note 1: in special cases such as those referred by considering gh), tighter limits may be required.

Note 2: It is recognised that, in principle, in some cases of narrowband and/or high power transmitters for all categories of services, there may be ~~objective~~ difficulties in meeting limits close to +/- 250% of the necessary bandwidth; these cases are reported in the specific annexes summarised in **Table 1**.

Note 3: when a system is coupled to an "Active Antenna System", the limits of **Table 1** should be met by the combined system; therefore compliance should be verified through an e.i.r.p. measurement (either near-field or far-field) and subsequent conversion to absolute power/attenuation values delivered to the transmission line, taking into account only the conventional "passive" gain (directivity) of the antenna.

7. that for fast switching induced spurious domain emissions, an additional limit for their peak power will be necessary, however further study should be carried on to investigate the nature of the phenomenon prior to fixing specific limits;
8. that, the limits specified within this Recommendation should be considered for new ETSI standards developed after the date at which the Recommendation is adopted.

In the case where the limits referred to in this Recommendation are found to be more stringent than existing ETSI Standards (TBR/ETS/EN/ES) a revision process may need to be considered. If revised, the standard should, whenever technically and economically feasible, meet the limits in this Recommendation.

Where either CEPT or ETSI consider the limits defined in this Recommendation are inappropriate for a particular standard an agreement on alternative limits should be reached by application of the MoU between ETSI and CEPT as published by ERO. A list of such agreements is given in Informative **Annex 8**;

9. that for all aspects not covered in this recommendation, ITU-R Recommendation SM.329 should apply; however, where applicable, ETSI standards or ITU-R Recommendations, if any, should be taken into account for methods of measurements of specific services;
10. that Administrations should afford all practicable protection to the frequencies utilised by the services using passive sensors referred to in considering [fg](#) (Annex 7 reports interference threshold values for these services, as referred by the relevant ITU-R recommendations). In bringing new services into operation, administrations are urged to note that transmitters can cause severe interference to other services through their spurious and out-of-band emissions, including far sidebands;
11. that for receivers any exclusion, such as 250% of the necessary bandwidth, quoted in [recommends 1](#) should not apply. Measurements should be made in accordance with [r](#)~~R~~ecommends 3 where the fundamental frequency range should include the highest oscillator frequency used in the receiver and the harmonics are those of the highest oscillator frequency.
12. that the active state of a transmission station is defined as the state which produces the authorised emission.
13. that the idle/standby state of a transmission station is defined as the state where the transmitter is available for traffic but is not in the active state.

TABLE 1

<u>LIMITS OF SPURIOUS DOMAIN EMISSIONS</u> SPURIOUS EMISSION		
Type of service (Note 1)	Limits	
Fixed Service	See Annex 1	
Land Mobile Service (Note 2) and Maritime Mobile Service (VHF) (mobiles and base stations)	See Annex 2	
Space Services	See Annex 3	
Broadcasting	See Annex 4	
Radar Systems in the Radiodetermination Service	See Annex 5	
Amateur services	See Annex 6	
Emergency position-indicating radio beacon, Emergency locator transmitter, Personal location beacon, Search and rescue transponder, Ship emergency, lifeboat, and survival craft transmitters; and Land, aeronautical or maritime transmitters when used in emergency.	No Limit	
All other services except those services quoted above:	Transmitters	Limits specified in Appendix S3 of the Radio Regulations apply
	Receivers and idle/standby transmitters	- 57 dBm 9 kHz ≤ f ≤ 1 GHz - 47 dBm 1 GHz < f (see recommend 11)

Note 1: In the relevant annexes summarised in this table, “analogue” and “digital” systems are referred to; for this purpose systems employing any modulation scheme that uses digital processing to quantise the carrier modulation are classified as “digital” systems.

Note 2: Annex 2 contains limits for land mobile systems (e.g. public cellular radio, professional mobile radio and radio local area networks) and also contains limits applicable to systems using similar technologies (e.g. short range devices, CB (citizens band), cordless telephones, radio microphones).

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ANNEX 1

FIXED SERVICE SPECIFIC REQUIREMENTS

1. Informative background

Fixed Service Digital Radio ~~Relay~~-Systems presently referred to in the specific ETSI TM4 work programmes, and used in CEPT countries, cover a very wide range of frequency bands of emission, traffic capacity, channel separations and modulation formats of which typical parameters are as follows:

frequency band	from below 1 GHz to 58 GHz
traffic capacity	from 9.6 kbit/s to 622 Mbit/s
channel separations	from 25 kHz to 220 MHz
modulation formats	from 2 to 1024 states (amplitude and/or phase and/or frequency states).

Analogue TV are the main analogue Radio Relay Systems of practical interest still placed in operation in the above frequency band; the necessary bandwidth of such analogue TV is not defined in any ITU-R Recommendation and, moreover, a wide variety of above-video sub-carriers are usually added to the main TV carrier.

2. Limits

ITU-R Recommendation F.1191 requires that, for Digital Radio ~~Relay~~-Systems, operating on a specific radio-frequency channel arrangement, the frequency boundaries between spurious and out-of-band ~~domains~~emissions are $\pm 250\%$ of the relevant Channel Separation (CS). Therefore, for the purpose of this recommendation, the frequency boundaries for spurious domain emissions of analogue and digital fixed service systems are taken, whenever applicable, as $\pm 250\%$ of the relevant CS of the radio-frequency channel arrangement where the system is to be placed.

According to ITU-R Recommendation F.1191, the Channel Separation (CS) is taken as $XS/2$ for alternated frequency channel arrangements and XS for co-channel and interleaved frequency channel arrangements as defined by ITU-R Recommendation F.746.

TABLE 1.1

LIMITS FOR FIXED SERVICE RADIO RELAY SYSTEMS	
Type of equipment	Limits mean power or, when applicable, average power during bursts duration in the reference bandwidth
Fixed Service (all stations except those below)	-50 dBm $9 \text{ kHz}^{(\text{note } 3)} \leq f \leq 21.2 \text{ GHz}^{(\text{note } 1)}$ -30 dBm $21.2 \text{ GHz} < f$ (see recommend 3) ^(note 1) (note 4)
Fixed Service - Terminal station (out station with subscriber equipment interfaces) ^(note 2)	-40 dBm $9 \text{ kHz}^{(\text{note } 3)} \leq f \leq 21.2 \text{ GHz}^{(\text{note } 1)}$ -30 dBm $21.2 \text{ GHz} < f$ (see recommend 3) ^(note 1) (note 4)
Fixed Service – Receivers	The same limits as for the transmitters above apply
<p>Note 1: For digital systems it is necessary to provide one or more steps of reference bandwidth to produce suitable transition area for the spectral density to manage the required limit because in some frequency bands and/or applications narrow band RF filters are not technically or economically feasible. Consequently, just outside the $\pm 250\%$ of the relevant Channel Separation, the limit of spurious emissions are defined with reference bandwidths as detailed by the specific Figure 1.1 and the related Table 1.2;</p> <p>Note 2: Point-to-Multipoint systems used in CEPT countries foresee three kind of stations: -MS Master (Central) Station (clearly identifiable in SM.329) -TS Terminal Station (also clearly identifiable in SM.329) -RS Repeater Station (which is not referred in SM.329); Repeater Stations of Point-to-multipoint systems will be considered as Terminal stations when they are intended for use only in Remote stations not co-located with any other Fixed radio equipment classified as Central station. <u>[When considering Multipoint-to-Multipoint (mesh) access systems, Multipoint-to-Multipoint stations providing co-frequency coverage to a defined area, without addressing any specific TS (in terms of antenna radiation pattern), should be considered as MS].</u></p> <p>Note 3: In ITU-R Recommendation SM.329 from 9 kHz to 30 MHz only Category A limits (i.e. -13 dBm) apply also when Category B is selected, however CEPT will propose revision to SM.329 in order to extend Category B limits down to 9 kHz.</p> <p><u>[Note 4: For Multipoint systems, with fundamental operating frequency higher than 21.2 GHz, the more stringent design objective reported in ETSI EN 301 390 should be taken into account].</u></p>	

In extreme cases, typically above 26 GHz and mostly due to the use of external mixers in the test set-up, it still may not be possible to achieve enough sensitivity to verify that the EUT conforms to the specification requirement under modulated condition. In these cases, the measurement may be carried out in un-modulated (CW) conditions. The measurement of the unwanted emissions in the spurious domain ~~emission measurement~~ in the CW condition may be corrected for those emissions that are subject to the modulation process, by an amount equal to the modulation loss of the EUT (i.e. the difference in dB between the power output and the power measured in the reference bandwidth at centre frequency of the carrier).

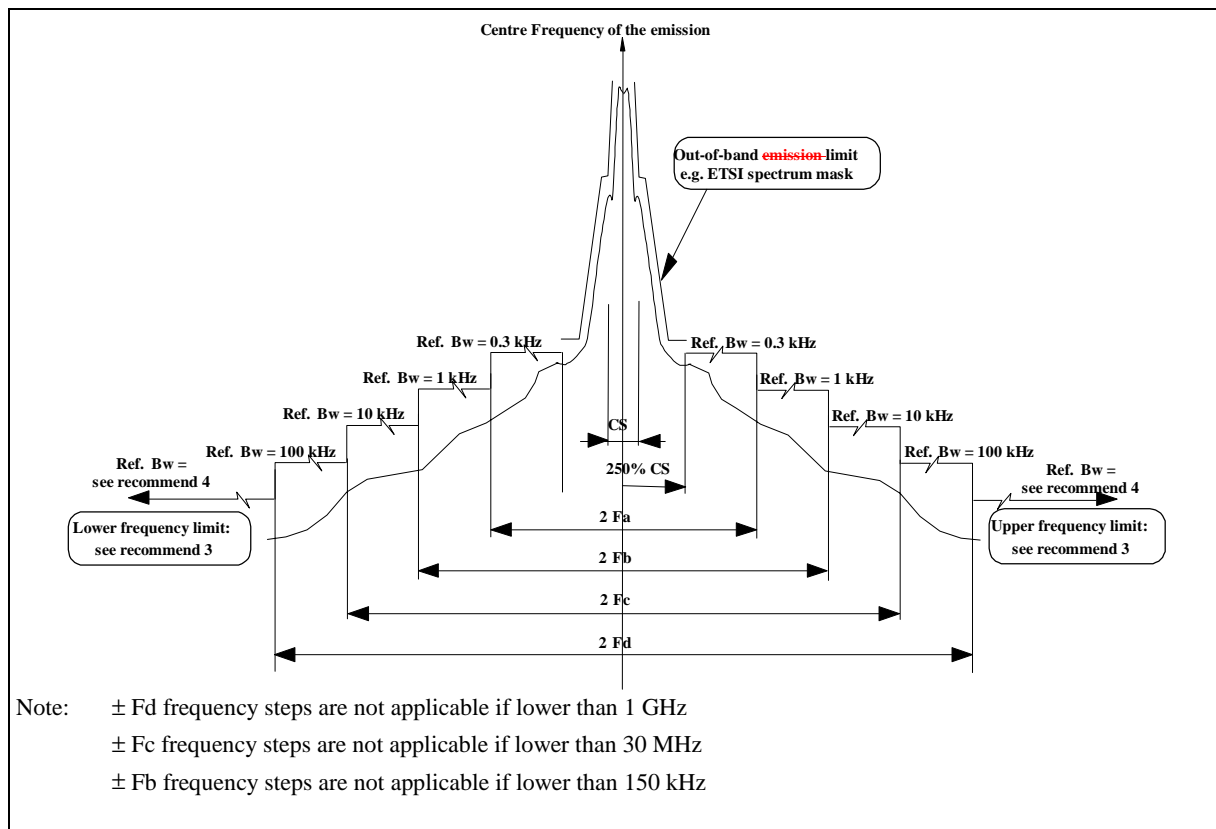


Figure 1.1

SPECIFIC SPURIOUS DOMAIN ~~EMISSIONS~~-LIMIT MASK (ref. to Table 1.2)

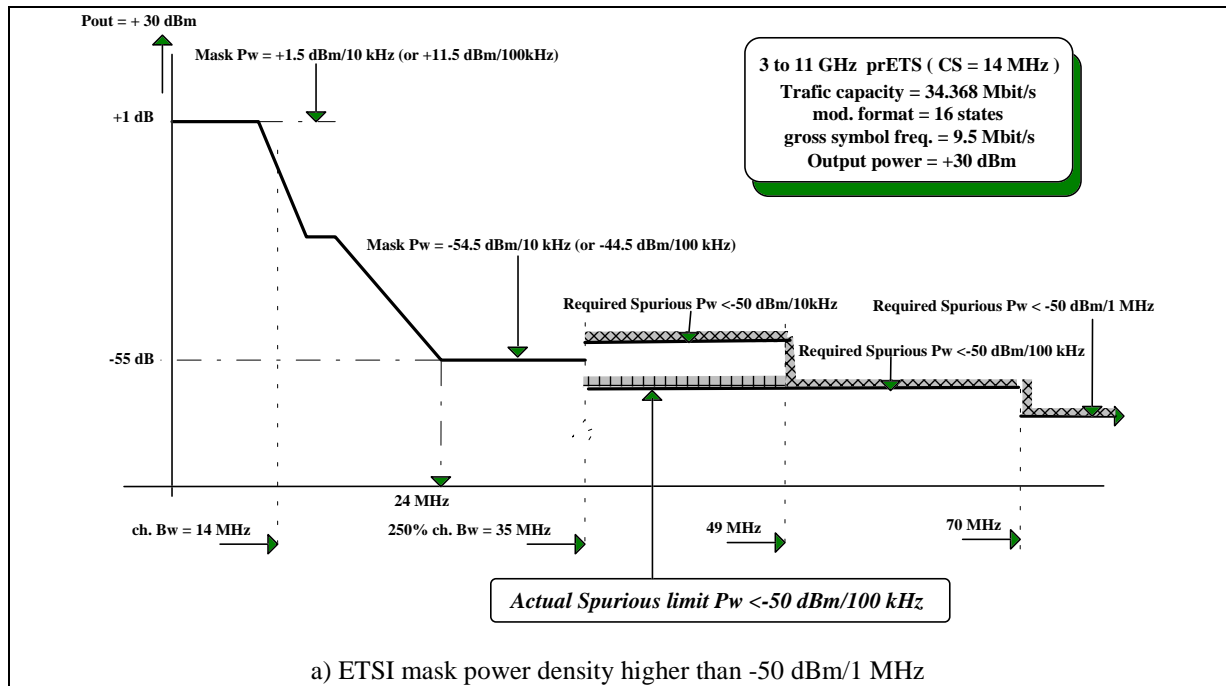
TABLE 1.2

VALUES OF Fa, Fb, Fc AND Fd						
Fundamental Emission Frequency	Channel Separation (CS) (MHz)	Typical Symbol Frequency (~Mbit/s)	Ref. BW 0.3 kHz	Ref. BW 1 kHz	Ref. BW 10 kHz	Ref. BW 100 kHz
			Fa* (MHz)	Fb* (MHz)	Fc* (MHz)	Fd* (MHz)
Below 21.2 GHz (Terminal stations)	$0.01 \leq CS < 1$	$F_s \approx 0.006 - 0.8$	-	-	14	70
	$1 \leq CS < 10$	$F_s \approx 0.6 - 8$	-	-	28	70
	$CS \geq 10$	$F_s \sim > 6$	-	-	49 (**)	70 (**)
Below 21.2 GHz (Other stations)	$0.01 \leq CS < 1$	$F_s \approx 0.006 - 0.8$	3.5	7	14	70
	$1 \leq CS < 10$	$F_s \approx 0.6 - 8$	-	14 (**)	28	70
	$CS \geq 10$	$F_s \sim > 6$	-	-	49 (**)	70 (**)
Above 21.2 GHz (All stations)	$1 \leq CS < 10$	$F_s \approx 0.6 - 8$	-	-	-	70
	$CS \geq 10$	$F_s > \sim 6$	-	-	-	-

(*) : The frequency limits are defined from the centre frequency of the emissions. For measurement purposes, the reference bandwidth given in **Table 1.2** apply to the frequency range extending from the 250% CS point to the first frequency limit indicated, from Fa to Fb, from Fb to Fc, or from Fc to Fd as appropriate.

(**): Not applicable for CS where the 250% point exceeds these values.

Note: It is recognised that, depending on the characteristic of the domain emissions, the actual power density relative to the ETSI mask at the $\pm 250\%$ boundary, when evaluated in the reference bandwidth of one or more steps of **Table 1.1**, may be lower than the spurious ~~emission~~ limit itself. In such cases these steps are not applicable and the first applicable spurious domain emission reference bandwidth step which corresponds to a power density equal or lower than that evaluated with the ETSI mask in the same reference bandwidth should be extended back to the $\pm 250\%$ boundary (examples of this concept are shown in **Figure 1.2**.)



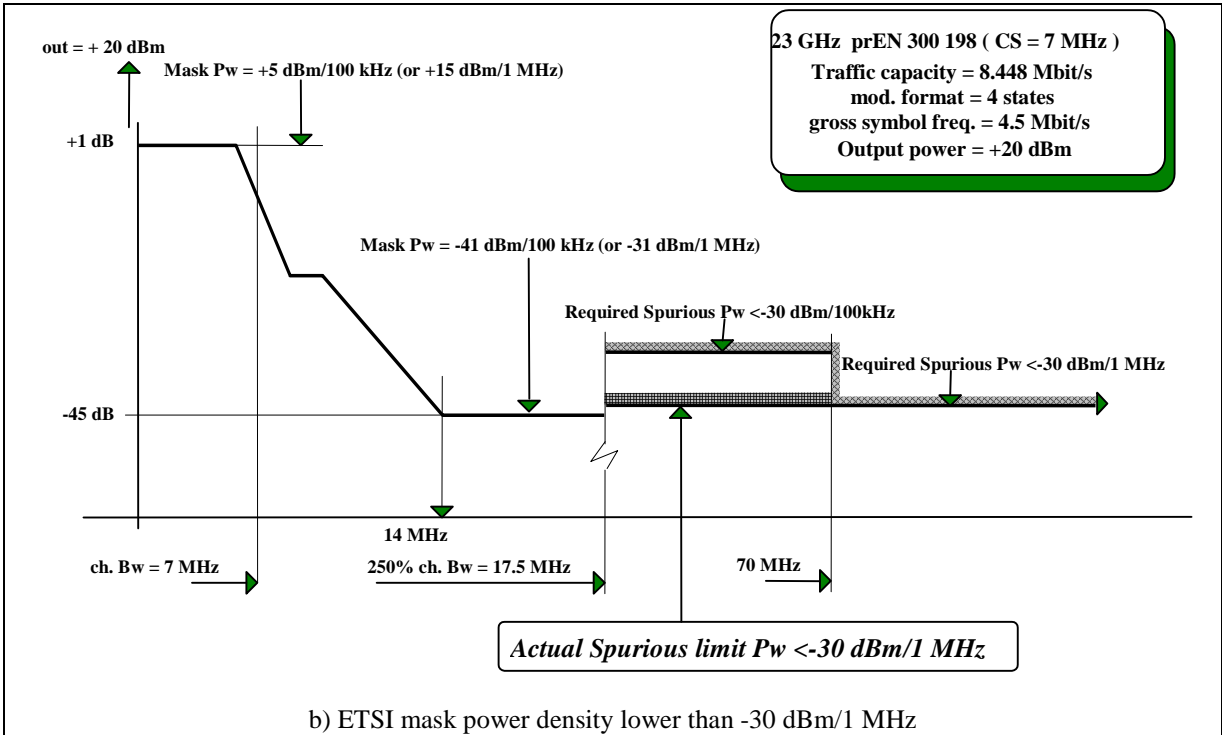


Figure 1.2

EXAMPLES OF ETSI MASK MORE STRINGENT THAN THE SPURIOUS DOMAIN EMISSION LIMITS IN THE REFERENCE BW

(ref. to note to Table 1.2)

ANNEX 2

LAND MOBILE SERVICE AND MARITIME MOBILE SERVICE (VHF)
SPECIFIC REQUIREMENTS

1. Limits

TABLE 2.1

LIMITS FOR THE LAND MOBILE SERVICE AND MARITIME MOBILE SERVICE (VHF)	
Type of equipment	Limits mean power or, when applicable, average power during bursts duration in the reference bandwidth
Terminals and Base Stations (in transmit mode) excluding the equipment below	-36 dBm $9 \text{ kHz} \leq f \leq 1 \text{ GHz}$
	-30 dBm $1 \text{ GHz} < f$ (see recommend 3)
Short range devices, CB, Cordless Telephones, Radio Microphones (all systems in transmit mode) <i>(note 2)</i>	-54 dBm f within the bands : 47–74 MHz, 87.5–118 MHz, 174–230 MHz, 470–862 MHz
	-36 dBm $9 \text{ kHz} \leq f \leq 1 \text{ GHz}$ (except above frequency bands)
	-30 dBm $1 \text{ GHz} < f$ (see recommend 3)
Short range inductive devices operating below 30 MHz (in transmit mode) <i>(note 2)</i>	27 dB μ A/m (at 9 kHz then decaying by 10 dB/decade) (Note 1) $9 \text{ kHz} \leq f \leq 10 \text{ MHz}$
	-3.5 dB μ A/m $10 \text{ MHz} < f \leq 30 \text{ MHz}$ (Note 1)
	-54 dBm f within the bands : 47–74 MHz, 87.5–118 MHz, 174–230 MHz, 470–862 MHz
	-36 dBm $30 \text{ MHz} < f \leq 1 \text{ GHz}$ (except above frequency bands)
	-30 dBm $1 \text{ GHz} < f$ (see recommend 3)
Receivers and idle/standby transmitters	- 57 dBm $9 \text{ kHz} \leq f \leq 1 \text{ GHz}$
	- 47 dBm $1 \text{ GHz} < f$ (see recommend 11)
Short range inductive receivers and idle/standby transmitters operating below 30 MHz	5.5 dB μ A/m descending 3 dB/octave $9 \text{ kHz} \leq f < 4.78 \text{ MHz}$
	-22 dB μ A/m $4.78 \text{ MHz} \leq f < 30 \text{ MHz}$
	-57 dBm $30 \text{ MHz} \leq f < 1 \text{ GHz}$
Notes : - f is the frequency of the spurious <u>domain</u> emission - for systems that use digital modulation and narrow-band high power (≥ 1 Watt) analogue modulated systems, the reference bandwidth is specified in section 2 of this annex, while for any other analogue modulation the reference bandwidth specified in recommend 4 is applicable,	
Note 1: Levels are H-field limit at 10 m distance, measured by shielded loop antenna as specified by CISPR.	
<i>Note 2: The limit of -54 dBm in the bands 47-74 MHz, 87.5-118 MHz, 174-230 MHz, 470-862 MHz is under review</i>	

APPLICATION OF REFERENCE BANDWIDTHS TO DIGITALLY MODULATED AND NARROW-BAND HIGH POWER ANALOGUE MODULATED MOBILE SERVICES

Narrow-band analogue modulated systems, with output power higher than 1 Watt and operated above 30 MHz, and digitally modulated systems although generally providing good spectrum efficiency, are unable to comply with the above limits for close-in frequencies due to the wideband noise generated by such systems. It is therefore necessary to provide specific steps of reference bandwidth in order to produce suitable transition area for the spectral density.

The specific reference bandwidth mask is shown in **Figure 2.1** for frequencies below 1 GHz and in **Figure 2.2** for frequencies above 1 GHz, with frequency limits which are a function of the channel separation or the necessary bandwidth (NB).

These masks apply to both mobile terminals and base stations.

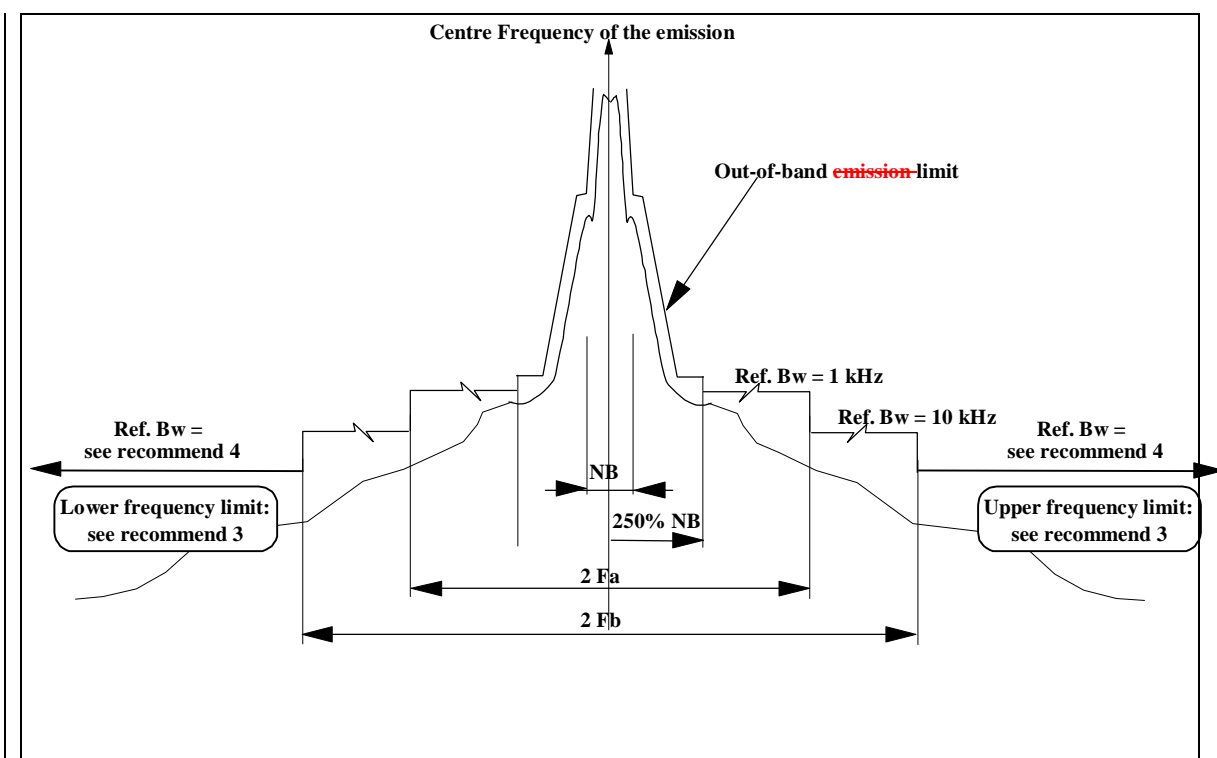


Figure 2.1

SPECIFIC SPURIOUS DOMAIN EMISSIONS MASK FOR MOBILE SERVICE OPERATING BETWEEN 30 MHz AND 1 GHz (refer TABLE 2.2)

TABLE 2.2

FREQUENCY REFERENCES for Figure 2.1

Fa*	100 kHz or 4 times NB, whichever is the greater
Fb*	500 kHz or 10 times NB, whichever is the greater

(*): The frequency limits are defined from the centre frequency of the emission. For measurement purposes, the reference bandwidths given in **Table 2.2** apply to the frequency range extending from the 250% CS point to the first frequency limit indicated or from Fa to Fb as appropriate.

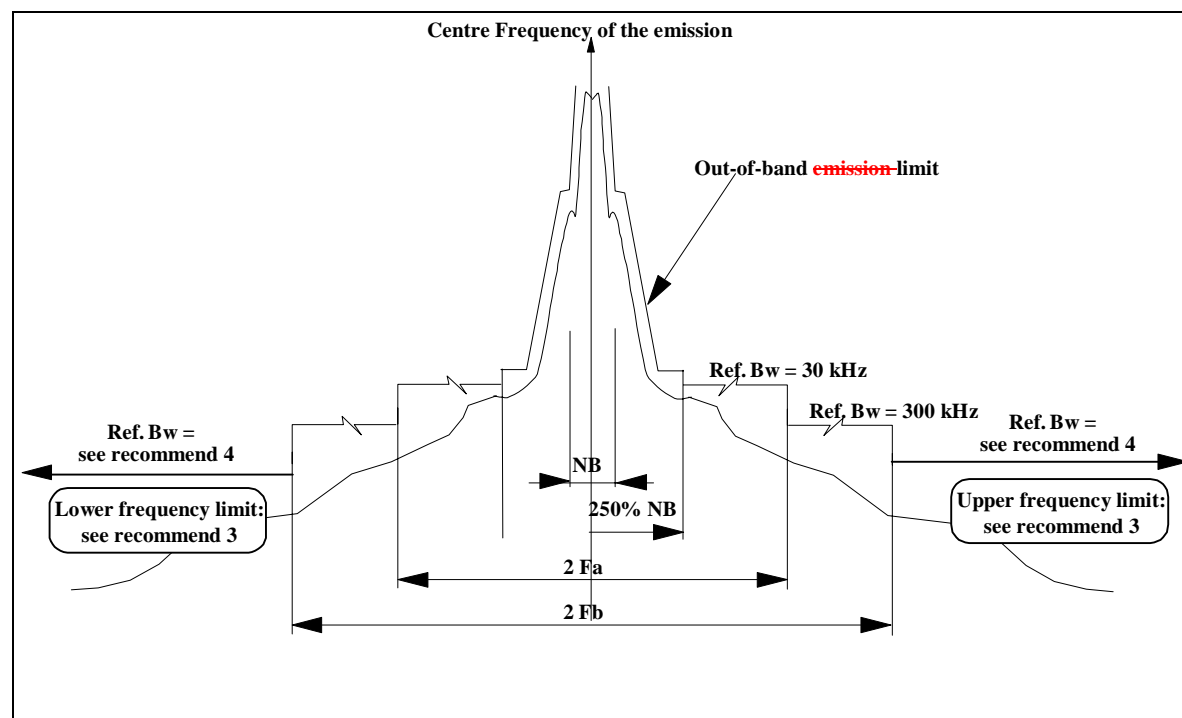


Figure 2.2
SPECIFIC SPURIOUS DOMAIN EMISSIONS LIMIT MASK FOR MOBILE SERVICE
OPERATING ABOVE 1 GHZ (REFER TABLE 2.3)

FREQUENCY REFERENCES FOR FIGURE 2.2

TABLE 2.3

Fa*	500 kHz or 10 times NB, whichever is the greater
Fb*	1 MHz or 12 times NB, whichever is the greater

(*): The frequency limits are defined from the centre frequency of the emission. For measurement purposes, the reference bandwidths given in **Table 2.3** apply to the frequency range extending from the 250% CS point to the first frequency limit indicated or from Fa to Fb as appropriate.

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ANNEX 3

SPACE SERVICE SPECIFIC REQUIREMENTS

TABLE 3.1

<u>SPURIOUS DOMAIN</u> LIMITS FOR SPACE SERVICES	
Type of equipment	Limits mean power or, when applicable, average power during burst duration in the reference bandwidth
VSAT (Very Small Aperture Terminal), SNG (Satellite News Gathering) or transportable fixed Earth Stations	$f \leq 1 \text{ GHz}$: EN55022 Class B limits $1 \text{ GHz} < f \leq 3.4 \text{ GHz}$: 49 dBpW/100 kHz $3.4 \text{ GHz} < f \leq 10.7 \text{ GHz}$: 55 dBpW/100 kHz $10.7 \text{ GHz} < f \leq 21.2 \text{ GHz}$: 61 dBpW/100 kHz $21.2 \text{ GHz} < f$ (see recommend 3) 67 dBpW/100 kHz (Values are in EIRP, see notes 1, 2 and 3)
VSAT, SNG or transportable fixed Earth Stations in transmission disabled state or receive only VSAT	$f \leq 1 \text{ GHz}$: EN55022 Class B limits $1 \text{ GHz} < f \leq 10.7 \text{ GHz}$: 48 dBpW/100 kHz $10.7 \text{ GHz} < f \leq 21.2 \text{ GHz}$: 54 dBpW/100 kHz $21.2 \text{ GHz} < f$ (see recommend 11) 60 dBpW/100 kHz (Values are in EIRP, see note 1)
Land Mobile Earth Stations below 1 GHz	-36 dBm $9 \text{ kHz} \leq f \leq 1 \text{ GHz}$ -30 dBm $1 \text{ GHz} < f$ (see recommend 3) The mask of Figure 2.1 and Table 2.2 applies. In order to evaluate the 250% boundary as well as Fa and Fb, the minimum necessary bandwidth shall be considered as 30 kHz for all emissions.
Land Mobile Earth Stations above 1 GHz	For a frequency offset larger than [X MHz or Y times NB, to be studied at appropriate time when future standards will be developed], terrestrial land mobile limits apply : -36 dBm $9 \text{ kHz} \leq f \leq 1 \text{ GHz}$ -30 dBm $1 \text{ GHz} < f$ (see recommend 3) The transition from the 250% NB to this frequency offset is also to be studied at appropriate time when future standards will be developed;
Transportable Land Mobile Earth Stations	Under Study
Land Mobile Earth Stations : receivers and standby/idle mode	$- 57 \text{ dBm}$ $9 \text{ kHz} \leq f \leq 1 \text{ GHz}$ $- 47 \text{ dBm}$ $1 \text{ GHz} < f$ (see recommend 11)
Other Fixed Earth Stations	Relative attenuation limits in Appendix S3 of the Radio Regulations apply. Alignments with VSAT and SNG limits are under consideration.

TABLE 3.1 continued

<p>Space stations (excluding Amateur Satellite Services which are covered under Annex 6), Maritime Mobile Earth Stations, Aeronautical Mobile Earth Stations</p>	<p>Relative attenuation Limits reported in Appendix S3 of the Radio Regulations apply.</p>
<p>Note 1: As a special case, the limits for VSAT, SNG or transportable fixed Earth Stations are expressed in terms of EIRP for off-axis angles greater than 7°.</p> <p>Note 2: In the frequency band of operation +/- 150 MHz, an EIRP limit of 78 dBpW/100 kHz applies. This limit may be exceeded in a frequency band which shall not exceed 80 MHz, centred on the carrier frequency, provided that the on-axis EIRP density at the considered frequency is 50 dB below the maximum on-axis EIRP density of the signal expressed in dBW/100 kHz. The frequency band of operation is the set of contiguous transmit frequency bands allocated to the FSS of the concerned region, or a continuous part of it, within which the equipment is designed to transmit, for use in accordance with the Radio Regulations.</p> <p>Note 3: In the second harmonic of the frequency band of operation +/- 400 MHz, for any 20 MHz band within which one or more spurious signals exceeding the above limit are present, then the power of each of those spurious signals exceeding the limit shall be added in watts, and the sum shall not exceed 78 dBpW.</p>	

ANNEX 4

BROADCASTING SERVICE SPECIFIC REQUIREMENTS

TABLE 4.1

<u>SPURIOUS DOMAIN LIMITS FOR THE BROADCASTING SERVICE</u>											
Type of equipment	Limits										
	Mean power absolute levels (dBm) or Attenuation (dBc) below the power ^(note 1) supplied to the antenna port in the reference bandwidth										
Broadcasting transmitters below 30 MHz	Limits of Radio Regulations Appendix S3 apply : 50 dBc, without exceeding the absolute mean power of 17 dBm										
All types of Broadcasting transmitters above 30 MHz	$9\text{kHz} \leq f$ (see recommend 3) : <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding-right: 20px;">-36 dBm</td> <td>$P \leq 9 \text{ dBW}$</td> </tr> <tr> <td>75 dBc</td> <td>$9 \text{ dBW} < P \leq 29 \text{ dBW}$</td> </tr> <tr> <td>-16 dBm</td> <td>$29 \text{ dBW} < P \leq 39 \text{ dBW}$</td> </tr> <tr> <td>85 dBc</td> <td>$39 \text{ dBW} < P \leq 50 \text{ dBW}$</td> </tr> <tr> <td>-5 dBm</td> <td>$50 \text{ dBW} < P$</td> </tr> </table>	-36 dBm	$P \leq 9 \text{ dBW}$	75 dBc	$9 \text{ dBW} < P \leq 29 \text{ dBW}$	-16 dBm	$29 \text{ dBW} < P \leq 39 \text{ dBW}$	85 dBc	$39 \text{ dBW} < P \leq 50 \text{ dBW}$	-5 dBm	$50 \text{ dBW} < P$
-36 dBm	$P \leq 9 \text{ dBW}$										
75 dBc	$9 \text{ dBW} < P \leq 29 \text{ dBW}$										
-16 dBm	$29 \text{ dBW} < P \leq 39 \text{ dBW}$										
85 dBc	$39 \text{ dBW} < P \leq 50 \text{ dBW}$										
-5 dBm	$50 \text{ dBW} < P$										
Broadcasting Receivers	Limits of EN55013 apply										
<p>Note 1 - mean power (P), in accordance with RR152, at antenna port in watts; For Analogue Television, the mean power level is defined with a specified video signal modulation. This video signal has to be chosen in such a way that the maximum mean power level (e.g. video signal blanking level for NTSC and PAL and maximum video level "white" for SECAM) is provided by the equipment.</p>											

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ANNEX 5

RADAR SYSTEMS IN THE RADIODETERMINATION SERVICE SPECIFIC REQUIREMENTS

The term "radiodetermination" includes ~~(aeronautical and maritime)~~ radionavigation and radiolocation for terrestrial and satellite services, examples are given in Figure 5.1. The radar systems used in these various services require special limits for spurious domain emissions.

Radars used in the radiodetermination service often require high e.i.r.p. to perform their missions and therefore special care is necessary to fulfil the requirements of other services in order to ensure compatibility with services in adjacent bands.

Spurious ~~emissions~~ limit for radiodetermination systems should take into consideration the platform type and mission of the radar. Limits for radiodetermination are divided into those for fixed stations and those for mobile stations as indicated in the table below.

Owing to the different types of modulation (fixed frequency radars, non-pulse-coded radars, phase-coded pulsed radars and swept-frequency such as FM or chirp radars) the spurious limits should be measured at the antenna output (radiated) as guided by the methods set out in ITU-R Recommendation M. 1177. The measurement methods and spurious ~~emission~~ limits shall take account of the attenuation of spurious domain emissions by the antenna.

The necessary reference bandwidths of the spurious emissions are indicated ~~under "recommend 4 or by Rec M.1177."~~ of this Recommendation.

The limits in the table below are minimum levels applicable to radars for radiodetermination. Except where otherwise provided by special recommendations the limits for "navigation aids" in the radionavigation service are the same as for those in the (aeronautical and maritime) mobile services.

Note: Radiolocation radars, deployed in SRD bands, are not subject to requirements of this annex; SRD limits in annex 2 should apply.]

TABLE 5.1

<u>LIMITS OF SPURIOUS DOMAIN EMISSIONS</u> LIMITS FOR RADAR SYSTEMS IN THE RADIODETERMINATION SERVICE¹	
Type of Radars for radiodetermination	Limits Absolute levels (dBm) or Attenuation (dB) below the power supplied to the antenna port
Fixed stations ² (wind profiler, multi-frequency, and active array radars are excluded ³)	PEP in the reference bandwidth : -30 dBm or 100 dB , whichever is less stringent
All other types of radar for radiodetermination	(43 + 10 logPEP), or 60 dB, whichever is less stringent these limits may be expressed in absolute PEP level in the reference bandwidth as : <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: center;">-13 dBm</div> <div style="text-align: center;">where PEP ≤ 50 W</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: center;">(10logPEP - 30) dBm</div> <div style="text-align: center;">where PEP > 50 W</div> </div>

1 Spurious ~~emission~~ limits in table 5.1 above apply to transmitters installed after 1 January 2006.

2 On a site by site basis, administrations may permit the use of maritime mobile radar equipment in fixed installations (e.g. Vessel Traffic Services radar), using the appropriate limits for mobile radars.

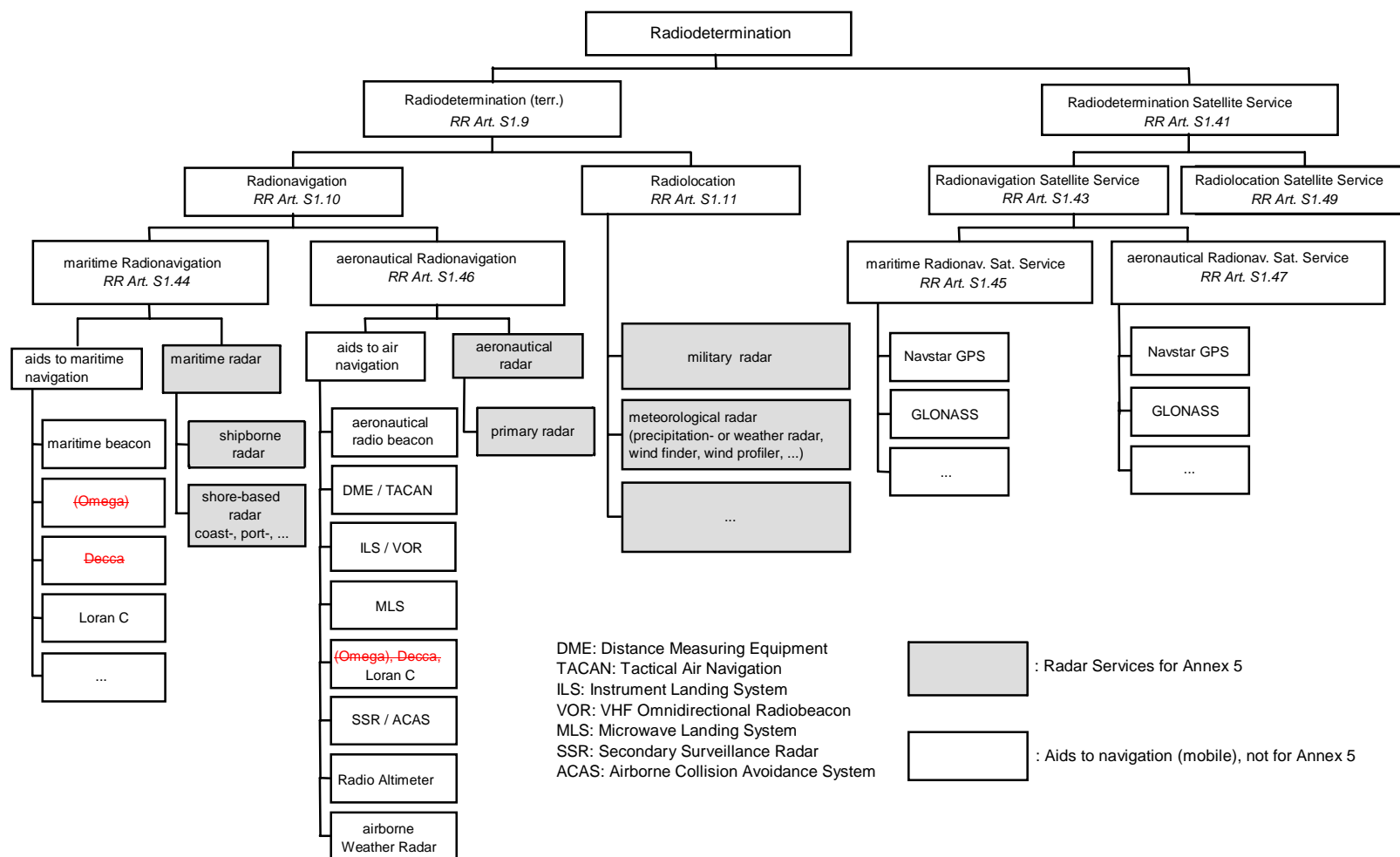
3 Further study is needed, any interference will be handled on a case by case basis.

Radar systems operating in standby mode	- 57 dBm	$9 \text{ kHz} \leq f \leq 1 \text{ GHz}$
	- 47 dBm	$1 \text{ GHz} < f$ (see recommend 3)
	No limit	Within $\pm 250\%$ of the necessary bandwidth

PEP = peak envelope power in Watts at the antenna port in accordance with RR ~~No. 151~~/S1.157.

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Fig. 5.1 Overview of Services in the Radiodetermination Service



ANNEX 6

AMATEUR SERVICES (INCLUDING AMATEUR SATELLITE SERVICE)
SPECIFIC REQUIREMENTS

TABLE 6.1

<u>SPURIOUS DOMAIN</u> LIMITS FOR AMATEUR SERVICE	
Type of equipment	Limits Attenuation (dB) below the power supplied to the antenna port
Amateur equipments operating below 30 MHz (including with SSB) (Note 1)	The following limit for PEP level in the reference bandwidth will be applicable: 43 + 10 log(PEP), or 50 dB (whichever is less stringent). The minimum Necessary Bandwidth used to evaluate the 250% boundary shall be considered as 4 kHz for all emissions.
SSB from mobile stations (Note 1)	PEP attenuation in the reference bandwidth: 43 dB below PEP. The minimum Necessary Bandwidth used to evaluate the 250% boundary shall be considered as 4 kHz for all emissions.
All equipments in the band 30 MHz to 1 GHz :	Limit for level in the reference bandwidth: 43 + 10 log(P), or 70 dBc, whichever is less stringent. The minimum Necessary Bandwidth used to evaluate the 250% boundary shall be considered as 25 kHz for all emissions.
All equipments between 1 GHz and 26 GHz	Limit for level in the reference bandwidth: 43 + 10 log(P), or 70 dBc, whichever is less stringent. The minimum Necessary Bandwidth used to evaluate the 250% boundary shall be considered as 100 kHz for all emissions.
All equipments above 26 GHz	Limit for level in the reference bandwidth: 43 + 10 log(P), or 70 dBc, whichever is less stringent. The minimum Necessary Bandwidth used to evaluate the 250% boundary shall be considered as 1 MHz for all emissions.
Space based Amateur satellite stations	Relative attenuation Limits specified in Appendix S3 of Radio Regulations apply.
Receivers and idle/standby transmitters	- 57 dBm 9 kHz ≤ f ≤ 1 GHz - 47 dBm 1 GHz < f (see recommend 11)

PEP = peak envelope power in Watts at the antenna port in accordance with RR ~~No. 151~~/S1.157.

P = mean power in watts at the antenna port, in accordance with RR S1.158. When burst transmission is used, the mean power P and the mean power of any spurious emissions are measured using power averaging over the burst duration.

dBc = decibels relative to the unmodulated carrier power of the emission. In the cases, which do not have a carrier, for example in some digital modulation schemes where the carrier is not accessible for measurement, the reference level equivalent to dBc is decibels relative to the mean power P.

Note 1: All classes of emission using SSB are included in the category "SSB."

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ANNEX 7 (INFORMATIVE)

THRESHOLD LEVELS OF INTERFERENCE FOR THE RADIO ASTRONOMY SERVICE AND SPACE SERVICES USING PASSIVE SENSORS

This annex reproduces the content of **Annex 3** and **Table 4** of ITU-R Recommendation SM.329-7. When further information is required, the latest version of that Recommendation should be consulted.

1 Introduction

Threshold levels of interference for the radio astronomy service, Earth exploration-satellite and meteorological-satellite services using passive sensors can be found in Recommendations ITU-R RA.769 and SA.1029. This Annex summarises the levels provided in these Recommendations.

2 Radio astronomy service (Recommendation ITU-R RA.769)

Table 7.1 gives the threshold levels of power flux density (pfd) and spectral power flux density (spfd) for interference detrimental to the radio astronomy service. These are calculated for observations with a single antenna and reception in sidelobes of gain 0dBi and an integration time of 2000 sec. The values of pfd and spfd given in **Table 7.1** apply generally, except for GSO satellites for which the pfd is 15 dB more stringent than shown (see Recommendation ITU-R RA.769-1).

[Annex 1 to Recommendation ITU-R RA.769 describes the methodology for calculating the sensitivity of various radio astronomy systems currently in use. It also provides, for assumed values of system parameters, tabulated levels of aggregate interference which are detrimental to both continuum and spectral-line measurements for various bands allocated to the radio astronomy service.](#)

[The assumed parameters used to derive these levels are representative of many types of radio astronomy systems and measurements and are an agreed acceptable standard within the radio astronomy service. However, there may be circumstances in coordination with a specific radio astronomy system, operating at a particular time and location in a particular band, where other values of these parameters may be used with the same methodology to derive a more appropriate level of detrimental interference. In addition, for consideration of interference from specific types of systems \(e.g. GSO satellites or multiple-satellite systems\) a systematic adjustment of the levels in Recommendation ITU-R RA.769 may be warranted. Accordingly, when the levels contained in Table 7.1 are applied or referred to, account should be taken of the assumptions used to derive them.](#)

TABLE 7.1

**THRESHOLD LEVELS OF POWER FLUX DENSITY AND SPECTRAL POWER FLUX DENSITY
OF INTERFERENCE DETRIMENTAL TO THE RADIO ASTRONOMY SERVICE**

Radio astronomy band MHz	Power flux density dB(W/m ²)	Spectral power flux density dB(W/m ² Hz)
13.36–13.41	-201	-248
25.55–25.67	-199	-249
73.0–74.6	-196	-258
150.05–153.0	-194	-259
322.0–328.6	-204	-258
406.1–410.0	-189	-255
608–614	-185	-253
1400–1427	-196	-255
1610.6–1613.8	-194	-238
1660–1670	-194	-251
2690–2700	-177	-247
4990–5000	-171	-241
GHz		
10.6–10.7	-160	-240
15.35–15.4	-156	-233
22.21–22.5	-162	-233
23.6–24.0	-161	-233
31.3–31.8	-141	-228
42.5–43.5	-153	-227
86–92	-144	-222
105–116	-141	-222
164–168	-136	-216
182–185	-135	-216
217–231	-133	-215
265–275	-131	-213

<u>Radio astronomy band⁽¹⁾ (MHz)</u>	<u>Continuum observations</u>		<u>Spectral lines observations</u>	
	<u>PFD (dB(W/m²))⁽²⁾</u>	<u>Assumed bandwidth (MHz)</u>	<u>PFD (dB(W/m²))⁽²⁾</u>	<u>Assumed spectral line channel bandwidth (kHz)</u>
<u>13.36-13.41</u>	<u>-201</u>	<u>0.05</u>	<u>(2)</u>	<u>(2)</u>
<u>25.55-25.67</u>	<u>-199</u>	<u>0.120</u>	<u>(2)</u>	<u>(2)</u>
<u>73.0-74.6</u>	<u>-196</u>	<u>1.6</u>	<u>(2)</u>	<u>(2)</u>
<u>150.05-153.0</u>	<u>-194</u>	<u>2.95</u>	<u>(2)</u>	<u>(2)</u>
<u>322.0-328.6</u>	<u>-189</u>	<u>6.6</u>	<u>-204</u>	<u>10</u>
<u>406.1-410.0</u>	<u>-189</u>	<u>3.9</u>	<u>(2)</u>	<u>(2)</u>
<u>608-614</u>	<u>-185</u>	<u>6</u>	<u>(2)</u>	<u>(2)</u>
<u>1 400-1 427</u>	<u>-180</u>	<u>27</u>	<u>-196</u>	<u>20</u>
<u>1 610.6-1 613.8</u>	<u>(3)</u>	<u>(3)</u>	<u>-194</u>	<u>20</u>
<u>1 660-1 670</u>	<u>-181</u>	<u>10</u>	<u>-194</u>	<u>20</u>
<u>2 690-2 700</u>	<u>-177</u>	<u>10</u>	<u>(2)</u>	<u>(2)</u>
<u>4 990-5 000</u>	<u>-171</u>	<u>10</u>	<u>(2)</u>	<u>(2)</u>
<u>(GHz)</u>				
<u>10.6-10.7</u>	<u>-160</u>	<u>100</u>	<u>(2)</u>	<u>(2)</u>
<u>15.35-15.4</u>	<u>-156</u>	<u>50</u>	<u>(2)</u>	<u>(2)</u>
<u>22.21-22.5</u>	<u>(3)</u>	<u>(3)</u>	<u>-162</u>	<u>250</u>
<u>23.6-24.0</u>	<u>-147</u>	<u>400</u>	<u>-161</u>	<u>250</u>
<u>31.3-31.8</u>	<u>-141</u>	<u>500</u>	<u>(2)</u>	<u>(2)</u>
<u>42.5-43.5</u>	<u>-137</u>	<u>1 000</u>	<u>-153</u>	<u>500</u>
<u>86-92</u>	<u>-125</u>	<u>6 000</u>	<u>-144</u>	<u>1 000</u>
<u>105-116</u>	<u>-121</u>	<u>11 000</u>	<u>-141</u>	<u>1 000</u>
<u>164-168</u>	<u>-120</u>	<u>4 000</u>	<u>(2)</u>	<u>(2)</u>
<u>182-185</u>	<u>(3)</u>	<u>(3)</u>	<u>-136</u>	<u>1 500</u>
<u>217-231</u>	<u>-114</u>	<u>14 000</u>	<u>-133</u>	<u>2 500</u>
<u>265-275</u>	<u>-113</u>	<u>10 000</u>	<u>-131</u>	<u>2 500</u>

* The levels are calculated under specific assumptions given in Recommendation ITU-R RA.769, in particular with an integration time of 2 000 s.

(1) These are the frequency bands listed in Recommendation ITU-R RA.769; eight further bands are allocated to the radio astronomy service on a primary basis via RR No. S5.555. Allocation to the RAS above 71 GHz have been changed by WRC-00. Rec ITU-R RA.769 is under revision and will contain the new allocation in future. The bands and the pfd values contained in the lower 6 lines of the Table are an information of the trend, only.

(2) Not listed in Table 2 of Recommendation ITU-R RA.769.

(3) Not listed in Table 1 of Recommendation ITU-R RA.769.

The conversion from power flux density to other power units may be found in **Table 7.3**.

**3 Earth Exploration-Satellite and Meteorological-Satellite passive sensing
(Recommendation ITU-R SA.1029)**

The permissible interference levels in Table 7.2 refer to power levels at the receiver input and do not include characteristics of the receiving antenna.

The permissible interference levels given in Table 7.2 are based on Recommendation ITU-R SA.1029. They refer to power levels at the receiver input and do not include characteristics of the receiving antenna. The gain of the receiving antenna may be inferred from the values of resolution (km) given in Table 2 of Recommendation ITU-R SA.515 and the knowledge that a typical orbital altitude for spaceborne remote sensors can be taken as 500 km. Note that for spaceborne remote sensing, the sensor antenna is normally directed at the Earth's surface. Note that the levels in Table 7.2 are described as permissible in the context that they meet the interference criteria of passive sensors. However, use of permissible may not necessarily conform with a strict regulatory definition.

PERMISSIBLE INTERFERENCE LEVEL AT THE RECEIVER INPUT

TABLE 7.2

Frequency (GHz)	Permissible interference level (dBW)	Interference-reference bandwidth (MHz)
Near 1.4	-171	27
Near 2.7	-174	10
Near 5	-161	100
Near 6	-164	100
Near 11	-163	20
Near 15	-166	50
Near 18	-155	100
Near 21	-163	100
22-235	-160	100
Near 24	-163	100
Near 30	-163	100
Near 37	-156	100
50 to 66	-161/-166 ⁽¹⁾	100
Near 90	-153	200
Above 100	-160	200

(1) Second level is for pushbroom sensors

<u>Frequency (GHz)</u>	<u>Interference level (dBW)</u>	<u>Interference reference bandwidth (MHz)</u>
<u>1.4-1.427</u>	<u>-171</u>	<u>27</u>
<u>2.69-2.7</u>	<u>-174</u>	<u>10</u>
<u>4.2-4.4</u>	<u>-161</u>	<u>100</u>
<u>6.5-6.7</u>	<u>-164</u>	<u>100</u>
<u>10.6-10.7</u>	<u>-163</u>	<u>20</u>
<u>15.2-15.4</u>	<u>-166</u>	<u>50</u>
<u>18.6-18.8</u>	<u>-155⁽¹⁾</u>	<u>100</u>
<u>21.2-21.4</u>	<u>-163</u>	<u>100</u>
<u>22.21-22.5</u>	<u>-160</u>	<u>100</u>
<u>23.6-24</u>	<u>-163</u>	<u>100</u>
<u>31.3-31.8</u>	<u>-163</u>	<u>100</u>
<u>36-37</u>	<u>-156</u>	<u>100</u>
<u>50.2-50.4</u>	<u>-161/-166⁽²⁾</u>	<u>100</u>
<u>52.6-59</u>	<u>-161/-166⁽²⁾</u>	<u>100</u>
<u>60.3-61.3</u>	<u>-161/-166⁽²⁾</u>	<u>100</u>
<u>86-92</u>	<u>-153</u>	<u>200</u>
<u>100-102</u>	<u>-160</u>	<u>200</u>
<u>105-126</u>	<u>-160</u>	<u>200</u>
<u>150-151</u>	<u>-160</u>	<u>200</u>
<u>155.5-158.5</u>	<u>-160</u>	<u>200</u>
<u>164-168</u>	<u>-160</u>	<u>200</u>
<u>175-192</u>	<u>-160</u>	<u>200</u>
<u>200-202</u>	<u>-160</u>	<u>200</u>
<u>217-231</u>	<u>-160</u>	<u>200</u>
<u>235-238</u>	<u>-160</u>	<u>200</u>
<u>250-252</u>	<u>-160</u>	<u>200</u>
<u>275-277</u>	<u>-160</u>	<u>200</u>
<u>300-302</u>	<u>-160</u>	<u>200</u>
<u>324-326</u>	<u>-160</u>	<u>200</u>
<u>345-347</u>	<u>-160</u>	<u>200</u>
<u>363-365</u>	<u>-160</u>	<u>200</u>
<u>379-381</u>	<u>-160</u>	<u>200</u>

⁽¹⁾ This value is under study.

⁽²⁾ Second number for pushbroom sensors.

4 Conversion table for radiated power

TABLE 7.3
CORRESPONDENCE BETWEEN EIRP, ERP, FIELD STRENGTH E
AND POWER FLUX DENSITY PFD

EIRP	EIRP	EIRP	EIRP	ERP	E field Free Space	E field max OATS*	pdf Free Space	pdf max OATS*
dBm	nW	dBpW	dBW	dBm	dB μ V/m at 10 m	dB μ V/m at 10 m	dBW/m ² at 10 m	dBW/m ² at 10 m
-90	0.001	0	-120	-92.15	-5.2	-1.2	-151.0	-147.0
-80	0.01	10	-110	-82.15	4.8	8.8	-141.0	-137.0
-70	0.1	20	-100	-72.15	14.8	18.8	-131.0	-127.0
-60	1	30	-90	-62.15	24.8	28.8	-121.0	-117.0
-50	10	40	-80	-52.15	34.8	38.8	-111.0	-107.0
-40	100	50	-70	-42.15	44.8	48.8	-101.0	-97.0
-30	1000	60	-60	-32.15	54.8	58.8	-91.0	-87.0
-20	10000	70	-50	-22.15	64.8	68.8	-81.0	-77.0
-10	100000	80	-40	-12.15	74.8	78.8	-71.0	-67.0
0	1000000	90	-30	-2.15	84.8	88.8	-61.0	-57.0

* OATS = Open Area Test Site

[Note: For background on conversion relationships, see Annex 1 of ITU-R SM.329-9](#)

ANNEX 8 (INFORMATIVE)

AGREEMENTS FOR ETSI STANDARDS OUTSIDE THE SCOPE OF THIS RECOMMENDATION

- 1. Systems designed under the assumption of draft EN301166: “Electromagnetic compatibility and Radio Matters (ERM); Land Mobile Service; Technical characteristics and test conditions for radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrowband channels and having an antenna connector”.**

For these narrow band systems the value of the frequency limit F_a referred in **Figure 2.1**, may be extended to a value not exceeding 250 kHz.

This special case is allowed until 2003. At this date, CEPT and ETSI will review, and if necessary revise, the standard in line with recommends 8 and the CEPT/ETSI MoU before removing the special case.

- 2. The ETSS reported below have fixed masks which were based upon first generation, narrowband techniques and which are now impossible to re-define in the form of variable masks of the table above.**

- 2.1 Satellite Earth Stations and Systems (SES); Low data rate Land Mobile satellite Earth Stations (LMES) operating in the 1,5/1,6 GHz frequency bands.**

The limits in ETS 300 254, and any TBRs and CTRs based on this ETS, do not have to comply with the limits given in the **Table 3.1**.

- 2.2 Satellite Earth Stations and Systems (SES); Land Mobile Satellite Earth Stations (LMESs) operating in the 1,5/1,6 GHz bands providing voice and/or data communications.**

The limits in ETS 300 423, and any TBRs and CTRs based on this ETS, do not have to comply with the limits given in the **Table 3.1**.

- 3. Until appropriate limits for Mobile Earth Stations above 1 GHz are defined, the limits given in the ETSS reported below should be applied in the relevant bands. It is anticipated that the limits in these ETSS will form the starting point for the development of appropriate limits and in due course these special cases will be removed.**

- 3.1 Satellite Earth Stations and Systems (SES); Satellite Personal Communications Networks (S-PCN); Mobile Earth Stations (MESs) including handheld earth stations, for S-PCN in the 1,6/2,4 GHz bands, providing voice and/or data communications under the Mobile Satellite Service (MSS).**

The limits in ETS 300 733, and any TBRs and CTRs based on this ETS, do not have to comply with the limits given in the **Table 3.1**.

- 3.2 Satellite Earth Stations and Systems (SES); Satellite Personal Communications Networks (S-PCN); Mobile Earth Stations (MESs) including handheld earth stations, for S-PCN in the 2.0 GHz bands, providing voice and/or data communications under the Mobile Satellite Service (MSS).**

The limits in ETS 300 734, and any TBRs and CTRs based on this ETS, do not have to comply with the limits given in the **Table 3.1**.