CEPT/ERC/RECOMMENDATION 74-01E (Siófok 1998, Nice 1999)

SPURIOUS EMISSIONS

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

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

Foreword

This Recommendation specifies spurious emission 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 Understanding[1] (ref. ETSI Collective Letter no. 866 of 26 Jan. 941). 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 ETSI[2] and CEPT[3] 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;

- The conclusions should be mutually acceptable and neither party should feel that its views have been disregarded;

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.

- 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 Radio 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 spurious emissions 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 spurious emissions 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 spurious emissions; moreover it provides some degree of freedom to Administrations, for the defined frequency boundaries for the definition of spurious emissions 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 ± 250% of the Necessary Bandwidth from the centre frequency of the emission; however it gives allowance for different definitions when practical;

e) that a revised appendix S3 has been approved at WRC'97, containing new limits mandatory from 2003;

f) 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) 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 Recommendation provided that it is possible to use special protection applied to either the source of interference, or the victim, or both;

h) 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) 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) that Spurious 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 Recommendation;

k) 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;

l) 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).

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 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 ± 250% of the relevant Channel Separation (CS) may be used.

Note 1: According to the Radio Regulations, the Necessary 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 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.

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

3. that the 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 frequency measurement 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 or Conformance Test Standards when available.

4. that the following reference bandwidths 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 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 emissions should be 4 kHz.

The reference bandwidths required for proper measurement of radar spurious emissions 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 1/1μs = 1 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 1/2μs = 0.5 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 MHz / 10μs)^{½} = 1.73 MHz.)

As a general rule, the resolution bandwidth of the measuring receiver should be equal to the reference bandwidth as given in this recommend. 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 spurii, normalisation is not applicable, while integration over the reference bandwidth is still applicable;

5. that the levels of spurious 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 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 g), 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 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 f) (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 recommend 1 should not apply. Measurements should be made in accordance with Recommends 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

SPURIOUS EMISSION LIMITS		
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 Annex4
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 emissions are ± 250% of the relevant Channel Separation (CS). Therefore, for the purpose of this recommendation, the frequency boundaries for spurious emissions of analogue and digital fixed service systems are taken, whenever applicable, as ± 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

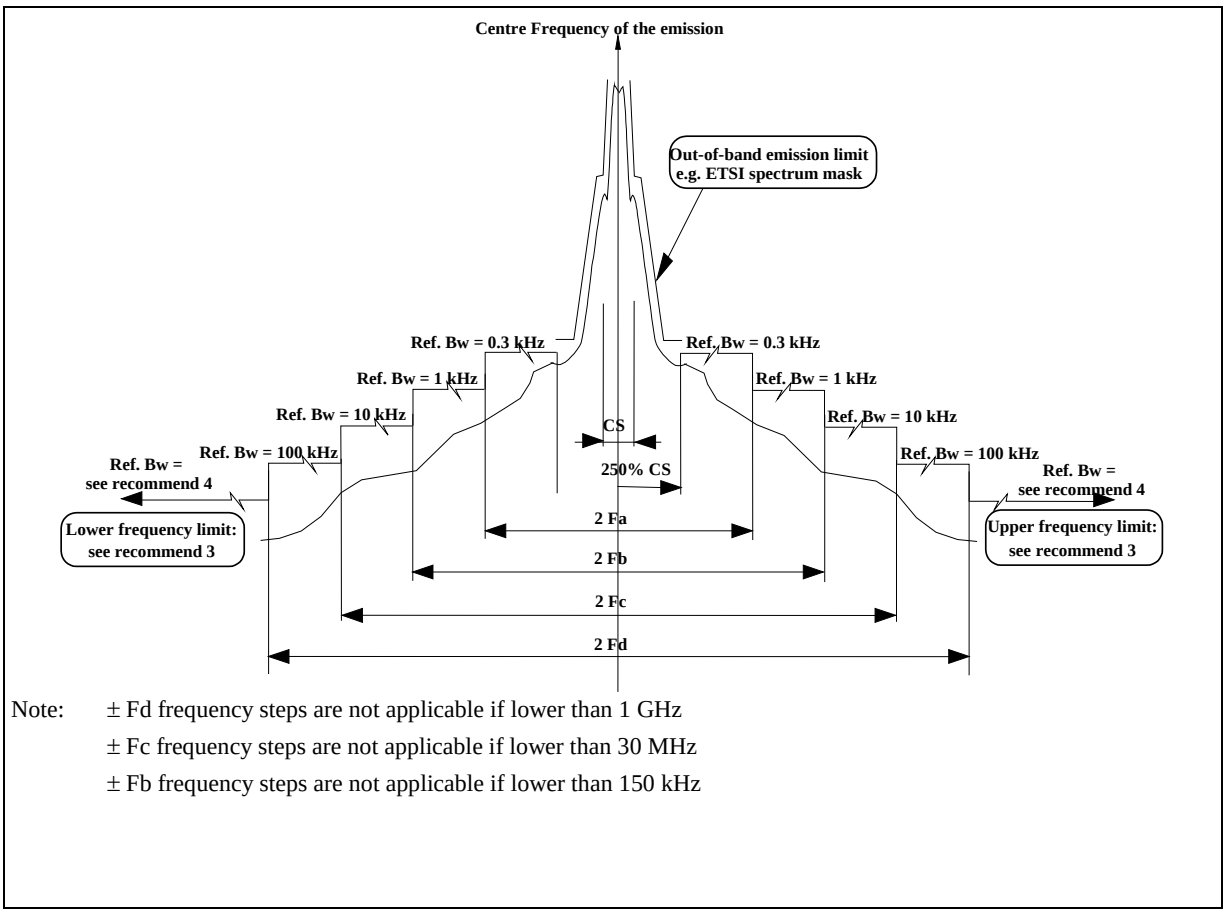
LIMITS FOR FIXED SERVICE RADIO RELAY SYSTEMS	
Type of equipment	**Limits** mean power or, when applicable, average power during bursts duration in the reference bandwidth
Fixed Service (all stations except those below)	-50 dBm 9 kHz [note 3] $\leq f \leq$ 21.2 GHz [note 1] -30 dBm 21.2 GHz < f (see recommend 3) [note 1]
Fixed Service - Terminal station (out station with subscriber equipment interfaces) [note 2]	-40 dBm 9 kHz [note 3] $\leq f \leq$ 21.2 GHz [note 1] -30 dBm 21.2 GHz < f (see recommend 3) [note 1]
Fixed Service – Receivers	The same limits as for the transmitters above apply

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 ± 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;

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.

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.

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 spurious 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).



Note: ± Fd frequency steps are not applicable if lower than 1 GHz
± Fc frequency steps are not applicable if lower than 30 MHz
± Fb frequency steps are not applicable if lower than 150 kHz

Figure 1.1

SPECIFIC SPURIOUS EMISSIONS LIMIT MASK (ref. to **Table 1.2**)

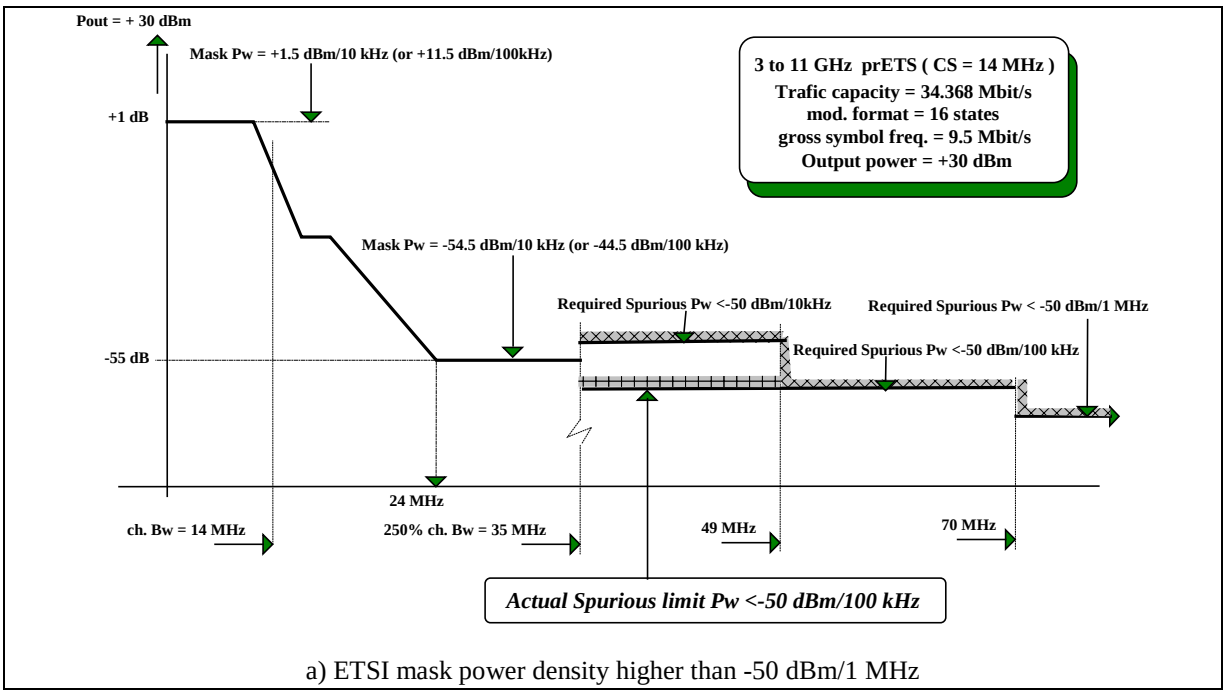
TABLE 1.2

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

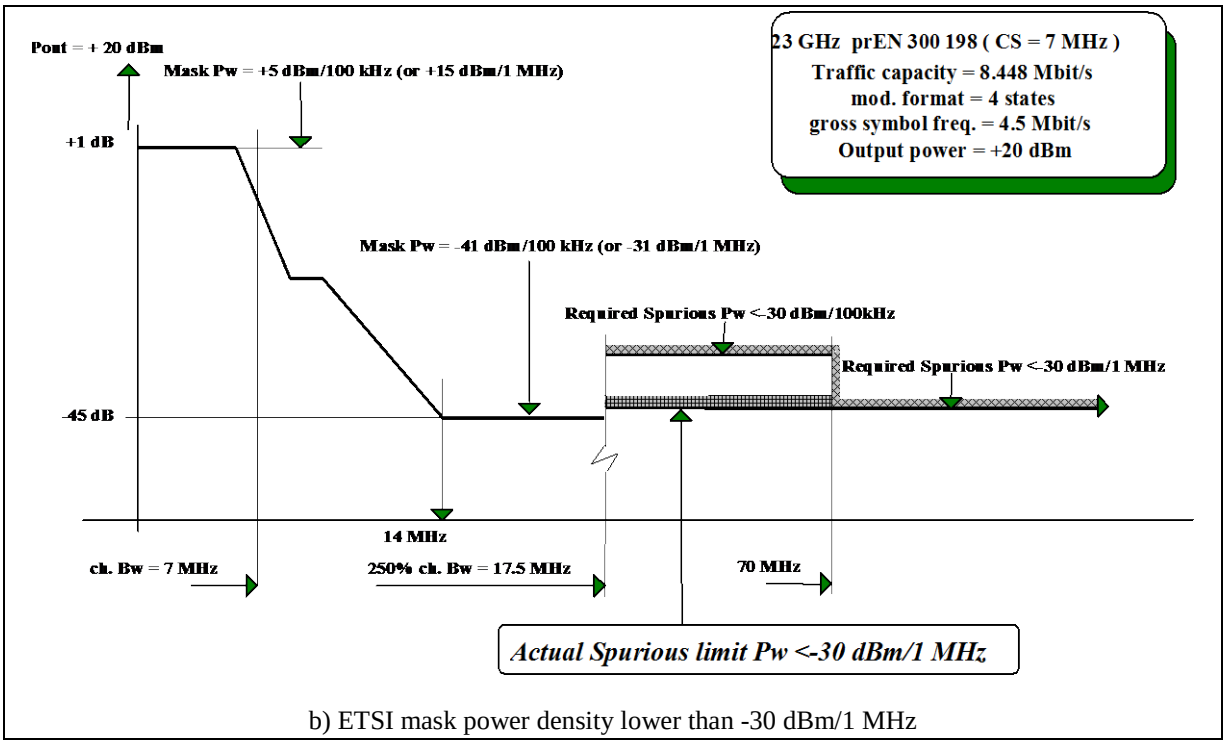
(*) : The frequency limits are defined from the centre frequency of the emissions. For measurement purposes, the reference bandwidth given in **Table 1.2** apply to the frequency range extending from the 250% CS point to the first frequency limit indicated, from Fa to Fb, from Fb to Fc, or from Fc to 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 emissions, the actual power density relative to the ETSI mask at the ± 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 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 ± 250% boundary (examples of this concept are shown in **Figure 1.2**.)



a) ETSI mask power density higher than -50 dBm/1 MHz



b) ETSI mask power density lower than -30 dBm/1 MHz

Figure 1.2

EXAMPLES OF ETSI MASK MORE STRINGENT THAN THE SPURIOUS 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 kHz ≤ *f* ≤ 1 GHz -30 dBm 1 GHz < *f* (see recommend 3)
Short range devices, CB, Cordless Telephones, Radio Microphones (all systems in transmit mode) (note 2)	-54 dBm *f* within the bands : 47–74 MHz, 87.5–118 MHz, 174–230 MHz, 470–862 MHz -36 dBm 9 kHz ≤ *f* ≤ 1 GHz (except above frequency bands) -30 dBm 1GHz < *f* (see recommend 3)
Short range inductive devices operating below 30 MHz (in transmit mode) (note 2)	27 dBµA/m (at 9 kHz then decaying by 10 dB/decade) (Note 1) 9 kHz ≤ *f* ≤ 10 MHz -3.5 dBµA/m 10 MHz < *f* ≤ 30 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 MHz < *f* ≤ 1 GHz (except above frequency bands) -30 dBm 1GHz < *f* (see recommend 3)
Receivers and idle/standby transmitters	- 57 dBm 9 kHz ≤ *f* ≤ 1 GHz - 47 dBm 1 GHz < *f* (see recommend 11)
Short range inductive receivers and idle/standby transmitters operating below 30 MHz	5.5 dBµA/m descending 3 dB/octave 9 kHz ≤ f < 4.78 MHz -22 dBµA/m 4.78 MHz ≤ f < 30 MHz -57 dBm 30 MHz ≤ f < 1 GHz

Notes : - f is the frequency of the spurious 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.

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.

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.

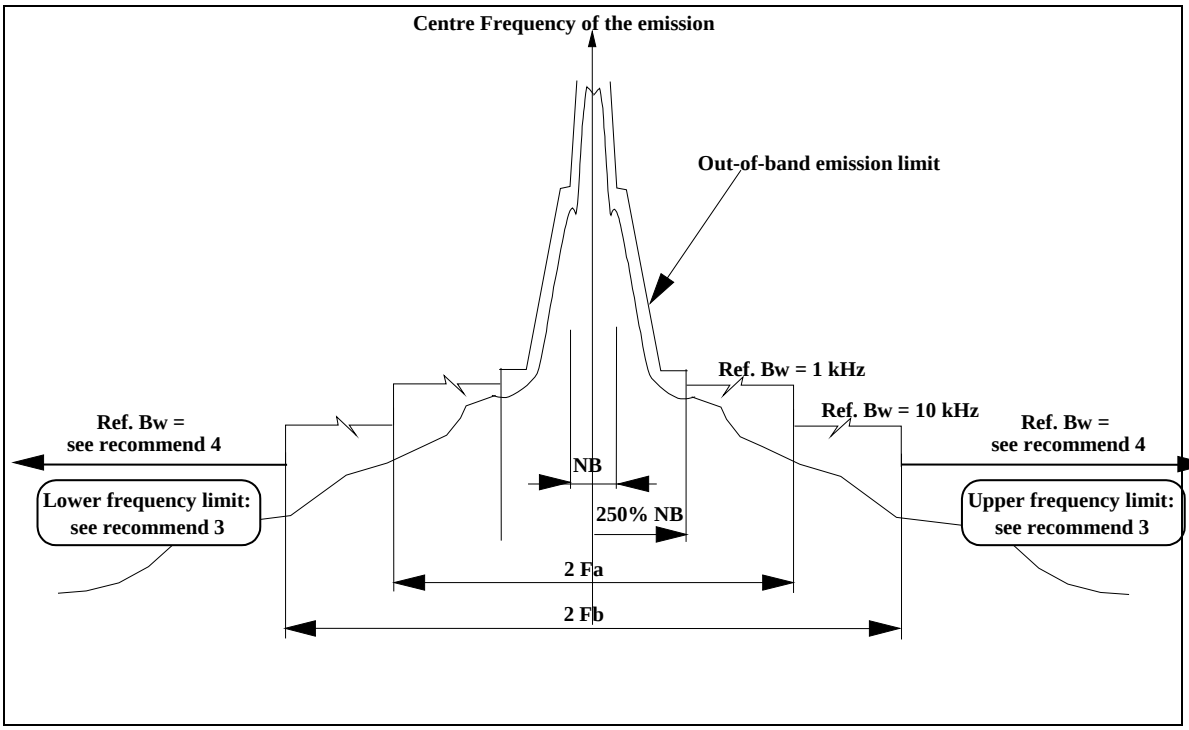


Figure 2.1

SPECIFIC SPURIOUS 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.

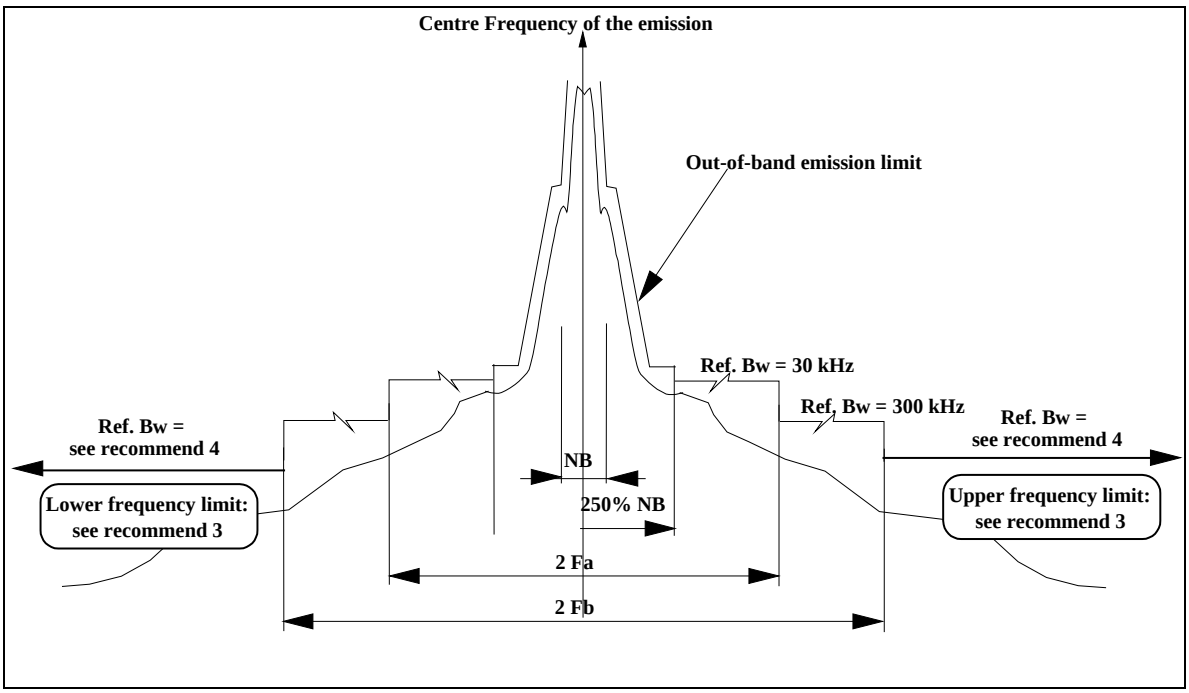


Figure 2.2
SPECIFIC SPURIOUS EMISSIONS LIMIT MASK FOR MOBILE SERVICE OPERATING ABOVE 1 GHZ (REFER TABLE 2.3)

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

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 ≤ 1 GHz : EN55022 Class B limits 1 GHz < f ≤ 3.4 GHz : 49 dBpW/100 kHz 3.4 GHz < f ≤ 10.7 GHz : 55 dBpW/100 kHz 10.7 GHz < f ≤ 21.2 GHz : 61 dBpW/100 kHz 21.2 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 ≤ 1 GHz : EN55022 Class B limits 1 GHz < f ≤ 10.7 GHz : 48 dBpW/100 kHz 10.7 GHz < f ≤ 21.2 GHz : 54 dBpW/100 kHz 21.2 GHz < f (see recommend 11) 60 dBpW/100 kHz (Values are in EIRP, see note 1)
Land Mobile Earth Stations below 1 GHz	-36 dBm9 kHz ≤ *f* ≤ 1 GHz -30 dBm1 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 dBm9 kHz ≤ *f* ≤ 1 GHz -30 dBm1 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 dBm 9 kHz ≤ *f* ≤ 1 GHz - 47 dBm 1 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

Space stations (excluding Amateur Satellite Services which are covered under **Annex 6**), Maritime Mobile Earth Stations, Aeronautical Mobile Earth Stations	Relative attenuation Limits reported in Appendix S3 of the Radio Regulations apply.

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°.

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.

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.

ANNEX 4

BROADCASTING SERVICE SPECIFIC REQUIREMENTS

TABLE 4.1

LIMITS FOR THE BROADCASTING SERVICE	
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	9kHz ≤ *f* (see recommend 3) : -36 dBm P ≤ 9 dBW 75 dBc 9 dBW < P ≤ 29 dBW -16 dBm 29 dBW < P ≤ 39 dBW 85 dBc 39 dBW < P ≤ 50 dBW -5 dBm 50 dBW < P
Broadcasting Receivers	Limits of EN55013 apply

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.

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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 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 emissions by the antenna.
The necessary reference bandwidths of the spurious emissions are indicated under "recommend 4." 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.

TABLE 5.1

LIMITS FOR RADAR SYSTEMS IN THE RADIODETERMINATION SERVICE[1]	
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 : -13 dBm where PEP ≤ 50 W (10logPEP - 30) dBm where PEP > 50 W
Radar systems operating in standby mode	- 57 dBm 9 kHz ≤ f ≤ 1 GHz - 47 dBm 1 GHz < f (see recommend 3) No limit Within ±250% of the necessary bandwidth

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

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.

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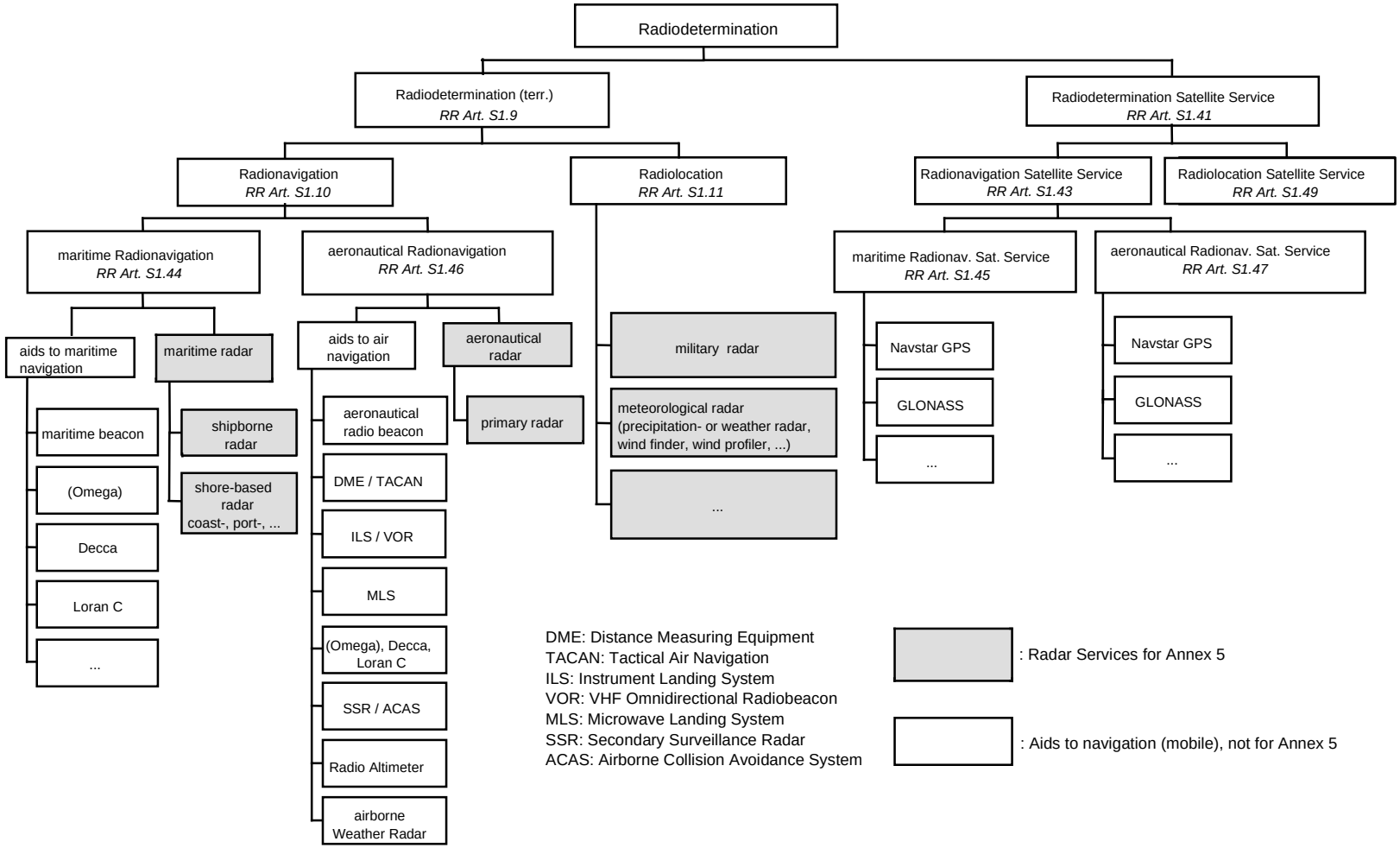
Fig. 5.1 Overview of Services in the Radiodetermination Service



ANNEX 6

AMATEUR SERVICES (INCLUDING AMATEUR SATELLITE SERVICE) SPECIFIC REQUIREMENTS

TABLE 6.1

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).

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^2Hz)
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

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.

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

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*	pfd Free Space	pfd max OATS*
dBm	nW	dBpW	dBW	dBm	dBµV/m at 10 m	dBµV/m at 10 m	dBW/m² at 10 m	dBW/m² 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

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 Fa 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**.