

ETSI EN 301 390 V2.1.1 (2021-11)



**Fixed Radio Systems;  
Point-to-point and Multipoint Systems;  
Unwanted emissions in the spurious domain and  
receiver immunity limits at equipment/antenna  
port of Digital Fixed Radio Systems**

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**Reference**

REN/ATTM-0452

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**Keywords**

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**ETSI**

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# Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

National transposition dates	
Date of adoption of this EN:	25 November 2021
Date of latest announcement of this EN (doa):	28 February 2022
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2022
Date of withdrawal of any conflicting National Standard (dow):	31 August 2022

## Major changes with respect to previous version

This revision is consequent to 2019 revision of CEPT/ERC Recommendation 74-01 [1], which revised the resolution bandwidth staircase for the limits of *unwanted emissions in the spurious domain* also for system with *channel separation* higher than 28 MHz and added specific limits for "*channels-aggregation*" systems as defined in ETSI EN 302 217-2 [i.7]. In addition, standing the poor penetration of multipoint systems in the so-called HD FS (High Density Fixed Service) bands (see 5.547 in the Radio Regulations [i.12]), limits for multipoint equipment with fundamental emission above 21,2 GHz have also been aligned to those required by CEPT/ERC Recommendation 74-01 [1].

Examples in clause B.2 have been updated as appropriate.

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## Modal verbs terminology

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## Introduction

The term Spurious emissions is used for simplicity elsewhere in the present document but with the more broader meaning of "*unwanted emissions in the spurious domain*" introduced by Recommendation ITU-R SM.329-12 [i.13] for clarifying the Radio Regulation definitions and the application of recommended limits for all *unwanted emissions*; it also recommends that spurious emissions limits apply to all unwanted emissions falling in the spurious domain.

Therefore the present document deals with limits for *unwanted emissions in the spurious domain* at antenna port of Digital Fixed Radio Systems (DFRS) as defined by Recommendation ITU-R SM.329-12 [i.13], CEPT/ERC Recommendation 74-01 [1] and ECC Recommendation (02)05 [i.18].

Moreover it covers characteristics of immunity from interference at receiver's antenna port.

*Unwanted emissions in the spurious domain* and immunity performance at antenna port are also relevant to essential requirements under article 3.2 of Directive 2014/53/EU [i.11] on Radio Equipment (RED).

Additional considerations and background for producing the present document are:

- Recommendation ITU-R SM.329-12 [i.13] considers emissions from any system, including digital modulation and allows options for the definition of the frequency boundary between *out-of-band domain* and *spurious domain*. It recommends different category of level limits applicable to the Fixed Service;
- Recommendation ITU-R SM.1539-1 [i.14] describes the application of the boundary concept between out-of-band and spurious domains;
- Recommendation ITU-R F.1191-3 [i.15] defines the application of Radio Regulations [i.12] and the concepts of out-of-band, unwanted and spurious emissions to DFRS, clarify the applicability for the boundary between out-of-band and Spurious emissions domains but maintain the same possible limit options provided by Recommendation ITU-R SM.329-12 [i.13];
- CEPT/ERC Recommendation 74-01 [1] endorses only the more stringent Category B limits of Recommendation ITU-R SM.329-12 [i.13];
- for the purpose of Directive 2014/53/EU [i.11], the emissions and immunity at antenna port fall under its article 3.2 requirements for "effective use of spectrum" and "avoidance of harmful interference";
- it is convenient to maintain a single ETSI EN covering these parameters instead of replicating them on each single product standard, avoiding possible deviation from what required by other CEPT and ITU-R normative;
- limits for *unwanted emissions in the spurious domain* are supposed to be fixed in view of inter-working compatibility among various Fixed Radio Systems in same or different band exploited in the same area;
- the measurement of the required limits should also be feasible in a suitable and cost effective conformance test (annex B gives also information in this field);
- it is necessary that DFRS receivers provide a minimum level of immunity at antenna port towards possible interference at any frequency band of practical interest;
- a suitable and easy to perform criterion for DFRS receivers immunity at antenna port may be considered the application of a CW interference.

---

# 1 Scope

The scope of the present document is to define specific limits at antenna port for *unwanted emissions in the spurious domain* and receiver immunity for suitable inter-working of Digital Fixed Radio Systems (i.e. Point-to-point and Multipoint systems) in the same or in different frequency band whenever allocated to Fixed Service in the range 9 kHz to 300 GHz.

However systems with fundamental emission below 30 MHz are not considered relevant for Digital Fixed Radio Systems and are outside the scope of the present document.

The present document adopts CEPT/ERC Recommendation 74-01 [1] which gives limits for Unwanted emissions in the Spurious domain with particular regards to "inter Services" operations.

In addition, it is recognized the need for a general requirement for receiver immunity to relatively high interference signals generated by any source and at any frequency in the same range identified as *spurious domain* by CEPT/ERC Recommendation 74-01 [1].

Some ETSI deliverables for DFRS provide limits for both "external" and "internal" spurious domain emissions and the latter are outside the scope of the present document. Moreover the limits for emissions given in the present document do not prevent more stringent requirement given in those deliverables for intra-system purpose (i.e. local Transmitter to Receiver interference usually referred as "internal").

In order to help the understanding of limits given in CEPT/ERC Recommendation 74-01 [1], in annex B, *unwanted emissions in the spurious domain* are analysed from the point of view of a suitable test method for conformance testing.

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## 2 References

### 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For a specific reference, only the cited version applies. For a non-specific reference, the latest version of the referenced document (including any amendments) applies.

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

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

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

- [1] CEPT/ERC Recommendation 74-01 (2019): "Unwanted emissions in the spurious domain".
- [2] Void.
- [3] ETSI EN 301 126-1: "Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment - Definitions, general requirements and test procedures".
- [4] ETSI EN 301 126-2-1: "Fixed Radio Systems; Conformance testing; Part 2-1: Point-to-Multipoint equipment; Definitions and general requirements".
- [5] ETSI EN 301 126-2-2: "Fixed Radio Systems; Conformance testing; Part 2-2: Point-to-Multipoint equipment; Test procedures for FDMA systems".
- [6] ETSI EN 301 126-2-3: "Fixed Radio Systems; Conformance testing; Part 2-3: Point-to-Multipoint equipment; Test procedures for TDMA systems".
- [7] ETSI EN 301 126-2-4: "Fixed Radio Systems; Conformance testing; Part 2-4: Point-to-Multipoint equipment; Test procedures for FH-CDMA systems".

- [8] ETSI EN 301 126-2-5: "Fixed Radio Systems; Conformance testing; Part 2-5: Point-to-Multipoint equipment; Test procedures for DS-CDMA systems".
- [9] ETSI EN 301 126-2-6: "Fixed Radio Systems; Conformance testing; Part 2-6: Point-to-Multipoint equipment; Test procedures for Multi Carrier Time Division Multiple Access (MC-TDMA) systems".

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For a specific reference, only the cited version applies. For a non-specific reference, the latest version of the referenced document (including any amendments) applies.

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

- [i.1] Void.
- [i.2] Void.
- [i.3] Void.
- [i.4] Void.
- [i.5] Void.
- [i.6] Void.
- [i.7] ETSI EN 302 217-2: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2: Digital systems operating in frequency bands from 1 GHz to 86 GHz; Harmonised Standard for access to radio spectrum".
- [i.8] ETSI EN 302 217-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview, common characteristics and requirements not related to access to radio spectrum".
- [i.9] ETSI TR 101 036-1: "Fixed Radio Systems; Generic wordings for standards on DFRS (Digital Fixed Radio Systems) characteristics; Part 1: General aspects and point-to-point equipment parameters".
- [i.10] Recommendation ITU-R F.746-10: "Radio-frequency arrangements for fixed service systems".
- [i.11] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.12] ITU-R Radio Regulations (2020).
- [i.13] Recommendation ITU-R SM.329-12: "Unwanted emissions in the spurious domain".
- [i.14] Recommendation ITU-R SM.1539-1: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329".
- [i.15] Recommendation ITU-R F.1191-3: "Necessary and occupied bandwidths and unwanted emissions of digital fixed service systems".
- [i.16] ECC Report 100: "Compatibility Studies in the Band 3400- 3800 MHz between Broadband Wireless Access (BWA) Systems and other Services".

[i.17] EC REF:Ares(2019)5616840 - Further response to the EC on ERC/REC 74-01 for ETSI X-band radar standards.

NOTE: Available as [ECC\(20\)093 Annex 14](#) (CEPT website password required).

[i.18] ECC Recommendation (02)05 (2012): "Unwanted emissions".

## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

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

**boundary between out-of-band and spurious domains:** frequency limit that subdivides the two domains and the applicability of relevant requirements

NOTE: Recommendations ITU-R SM.329-12 [i.13] and SM.1539-1 [i.14] describe the possible application to all radio emissions. Recommendation ITU-R F.1191-3 [i.15] details it for Fixed Service systems.

**Broadband Wireless Access (BWA) system:** access system used for the deployment of radio access networks in both the fixed service and the mobile service

NOTE: BWA applications were introduced by ECC Report 100 [i.16] as:  
*"BWA systems were considered in the report, covering various BWA usage modes, i.e. Fixed (FWA), Nomadic (NWA) and Mobile (MWA) Wireless Access"*.  
 Therefore, the technology of BWA may indifferently refer to the fixed or the mobile service regulation.

**Channel Separation (CS):** distance between adjacent channels in a radio frequency channels arrangement (defined in ECC or ITU-R or national recommendations)

NOTE 1: It represents one of the major parameters for the identification of the radio equipment use and relevant requirements.

NOTE 2: Some channel arrangements give only a continuous raster of elementary frequency slots for composing multiple ( $N \times$  elementary slot) aggregated channels of various size. In this case the actual CS would be equal to the  $N \times$  elementary slot used by the radio system. When no channel arrangement or elementary slot raster is defined in the band of operation of the radio system, the *occupied bandwidth* should be considered in substitution of the CS.

**Continuous Wave (CW) signal:** signal with spectral emission on a single frequency only

NOTE: Unavoidable phase-noise spectral components of the CW source are not to be taken into account.

**EN:** European Standard (Telecommunications series)

**evaluation bandwidth:** bandwidth where the spurious domain emission limits are measured (e.g. the spectrum analyser resolution bandwidth) for further normalization/integration to the reference bandwidth

**Gross Symbol Frequency  $G_{SF}$ :** the maximum frequency of variance of the different states of the modulator (e.g. 256 states for 256 QAM modulation formats); it is equal to the maximum (gross) bit rate (i.e. inclusive of any payloads, control and service data, overhead and error correction codes to be transmitted) divided by the modulation index "n" (e.g.  $n = 8$  for  $2^n = 256$  in 256 QAM)

**necessary bandwidth** (1.152 of Radio Regulations [i.12]):

*"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"*

NOTE: Recommendation ITU-R F.1191-3 [i.15] establishes that for DFRS the *necessary bandwidth* is considered coincident with the *occupied bandwidth*.

**noise-like emissions:** emissions characterized by a distributed power density within the *reference* and *evaluation bandwidths*



**occupied bandwidth** (1.153 of Radio Regulations [i.12]):

"width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage  $\beta/2$  of the total mean power of a given emission (Radio Regulations [i.12])"

NOTE: For the purpose of the present document,  $\beta/2$  is assumed to be equal to 0,5 % (Recommendation ITU-R F.1191-3 [i.15]).

**out-of-band domain (of an emission)** (1.146A of Radio Regulations [i.12]):

"frequency range, immediately outside the *necessary bandwidth* but excluding the *spurious domain*, in which *out-of-band emissions* generally predominate.

*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. However, the limit in the out-of-band-domain applies to any *unwanted emissions* independently from their formal identification as out-of-band or spurious emissions"

**receiver spurious emissions:** spurious sent backwards to the antenna port by a receiver

NOTE: Sometimes they are also referenced as "spurious radiations".

**reference bandwidth:** bandwidth where the spurious emission limits are defined

NOTE: See also Recommendation ITU-R SM.329-12 [i.13].

**spurious domain (of an emission)** (1.146B of Radio Regulations [i.12]):

"frequency range beyond the *out-of-band domain* in which *spurious emissions* generally predominate.

*Spurious emissions* may occur in the *out-of-band domain* as well as in the *spurious domain*. Likewise *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*. However, the limit in the *spurious-domain* applies to any *unwanted emissions* independently from their formal identification as *out-of-band* or *spurious emissions*"

**unwanted emissions** (1.146 of Radio Regulations [i.12]):

"emissions composed by *out-of-band* and *spurious emissions*"

**unwanted emissions in the out-of-band domain:** any unwanted emission, outside the channel bandwidth, which falls at frequencies separated from the centre frequency of the emission by less than 250 % (see note) of the relevant *Channel Separation* (CS), where the system is intended to be used

NOTE: When CS > 500 MHz the 250 % should be substituted by (150 % CS + 500 MHz), see CEPT/ERC Recommendation 74-01 [1].

**unwanted emissions in the spurious domain :** any unwanted emission which falls at frequencies separated from the centre frequency of the emission by 250 % (see note) or more of the relevant *channel separation*, where the system is intended to be used

NOTE: When CS > 500 MHz the 250 % should be substituted by (150 % CS + 500 MHz), see CEPT/ERC Recommendation 74-01 [1].

## 3.2 Symbols

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

dBc	decibels relative to carrier mean power
dB <sub>i</sub>	decibel relative to an isotropic radiator
dB <sub>m</sub>	decibels relative to milliwatt
GHz	GigaHertz
kHz	kiloHertz
MHz	MegaHertz

### 3.3 Abbreviations

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

ATe	external ATtenuator
ATi	internal spectrum analyser input ATtenuator
ATPC	Automatic Transmission Power Control
BER	Bit Error Rate
BS	Base (Master) Station of a P-MP system
BW	BandWidth
BWA	Broadband Wireless Access
BWe	evaluation BandWidth for spectral measurement

NOTE: I.e. spectrum analyser resolution bandwidth.

BW <sub>r</sub>	reference BandWidth
CEPT	Conférence Européenne des administrations des Postes et des Télécommunications (European Conference of Postal and Telecommunications administrations)
CS	Channel Separation
CW	Continuous Wave
DFRS	Digital Fixed Radio Systems
DUT	Device Under Test
EC	European Commission
ECC	Electronic Communication Committee of the CEPT
EN	European Norm
ERC	European Radiocommunications Committee of the CEPT, presently become ECC
F <sub>c</sub>	cut-off Frequency
FS	Fixed Service
G <sub>SF</sub>	Gross Symbol Frequency
HDFS	High Density Fixed Service
i.m.p.	intermodulation products
IM	InterModulation
ITU-R	International Telecommunication Union - Radiocommunications standardization sector
MP	MultiPoint

NOTE: Generic term including both P-MP and MP to MP mesh architectures.

NB	Necessary Bandwidth
OJEU	Official Journal of European Union
P-MP	Point-to-MultiPoint system
P-P	Point-to-Point system
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
RS	Repeater Station (of a P-MP system)
RSL	Receiver Signal Level
Rx	Receiver
SM	Spectrum Management
STM-0	Synchronous Transport Module Level 0
STM-1	Synchronous Transport Module Level 1
TS	Terminal Station

NOTE: Remote out-station with subscriber interface of a P-MP system.

Tx	Transmitter
VSWR	Voltage Standing Wave Ratio
WRC	World Radio Conference

## 4 Transmitter unwanted emissions in the spurious domain at antenna port

### 4.1 Background

For the purpose of the present document the terms defined in clause 3.1 are printed in "*italic*".

The *spurious domain* (of an emission) is defined in the Radio Regulations [i.12] 1.146B (see clause 3.1).

For Fixed Service (FS), CEPT/ERC Recommendation 74-01 [1] is based on Recommendation ITU-R SM.329-12 [i.13] and its applicability to FS provided by Recommendation ITU-R F.1191-3 [i.15].

CEPT/ERC Recommendation 74-01 [1] prescribes that the *spurious domain* emissions limits are applied to any *unwanted emissions* at frequencies which are:

- For *channel separations* (CS)  $\leq 500$  MHz:  
at frequencies which are outside the [nominal] carrier frequency by more than  $\pm 250$  % of the relevant CS.
- For *channel separation* (CS)  $> 500$  MHz:  
as given in Recommendation ITU-R SM.1539-1 [i.14] at frequencies which are outside the [nominal] carrier frequency by more than  $\pm (500 \text{ MHz} + 150 \% \text{ CS [MHz]})$ .

According Recommendation ITU-R F.1191-3 [i.15], 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 Recommendation ITU-R F.746-10 [i.10].

The emission within  $\pm 250$  %, or in case  $\pm (500 \text{ MHz} + 150 \%)$ , of the relevant *channel separation* includes only fundamental and *unwanted emissions in the out-of-band domain* (which are outside the scope of the present document). The out of band domain is defined in Radio Regulations [i.12] 1.146A (see clause 3.1).

### 4.2 Limits

#### 4.2.0 Generality

The *unwanted emissions in the spurious domain* of the transmitter and the *receiver spurious emissions*, delivered to the antenna port of Fixed Radio Systems, shall be limited within the average power limits reported below.

For "*noise-like unwanted emissions*", the limits are intended not to be exceeded in any elementary *evaluation bandwidth*.

The limit values are defined at reference point C' shown in the general RF block diagram of figure 1.

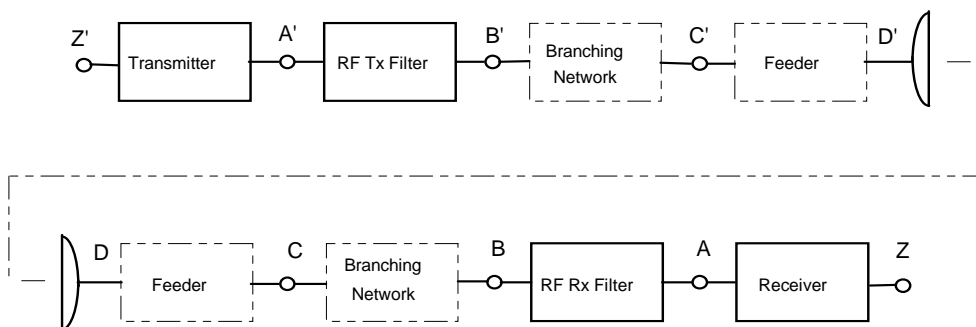


Figure 1: RF block diagram

### 4.2.1 Point-to-point equipment

The CEPT/ERC Recommendation 74-01 [1] and its FS specific annex 1 shall apply.

For reader convenience, annex A gives the details for its application to practical systems.

### 4.2.2 Multipoint equipment

The CEPT/ERC Recommendation 74-01 [1] and its FS specific annex 1 shall apply.

For reader convenience, annex A gives the details for its application to practical systems.

### 4.2.3 Broadband Wireless Access equipment operating between 1 GHz and 6 GHz

*Broadband Wireless Access (BWA)* systems are used for the deployment of radio access networks in both the fixed service and the mobile service. They operate at frequencies up to 6 GHz and are considered to use terminal stations with antenna gain less than about 20 dBi.

The CEPT/ERC Recommendation 74-01 [1] and its FS specific annex 1 shall apply.

For reader convenience, annex A gives the details for its application to practical systems.

---

## 5 Receiver spurious emissions at the antenna port

*Receiver spurious emissions* are defined in the same frequency range of transmitters spurious domain emissions, without any exclusion band (such as the 250 % of the relevant *channel separation*) and are applicable at the reference point C of figure 1.

The CEPT/ERC Recommendation 74-01 [1] and its FS specific annex 1 shall apply.

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## 6 Spurious domain emissions test method

The measurement shall be referenced at the Tx/Rx common antenna port (reference points C-C' of figure 1).

According to the equipment physical construction, the test shall be carried on with the methodologies given, for P-P equipment, in ETSI EN 301 126-1 [3] and, for P-MP equipment, according their access methods, in ETSI EN 301 126-2-1 [4], ETSI EN 301 126-2-2 [5], ETSI EN 301 126-2-3 [6], ETSI EN 301 126-2-4 [7], ETSI EN 301 126-2-5 [8] and ETSI EN 301 126-2-6 [9]. The measurement shall be carried out with transmitters set to the higher level of continuous emission (see note) with the payloads inputs connected to a suitable test pattern, defined, for the equipment under consideration, in the applicable ETSI deliverable, if available, or by manufacturer declaration.

In order to provide easy and cost effective Conformance Test, the measurement may be carried out with wider BWe, provided that the results will be normalized to the required bandwidth with the methods reported in CEPT/ERC Recommendation 74-01 [1].

NOTE: With ATPC disabled and set to the higher emission power.

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## 7 Receiver immunity at antenna port

### 7.0 Definitions

The receiver immunity at antenna port is ability of a receiver to perform within a predefined degradation in the presence, at its antenna port, of an interfering signal within a range of frequency outside its operating, first and second adjacent channels.

A suitable and easy to perform criterion is considered the application of a *continuous wave* CW spurious interference.

CW spurious interference sensitivity of a receiver is a measure of its ability to discriminate between the wanted signal at the nominal channel frequency of the receiver and a CW unwanted signal at any other frequency at which a response is obtained.

## 7.1 Limits

Unless different requirements were reported into a specific product ETSI deliverable, for a receiver operating at a RSL corresponding to the nominal  $10^{-6}$  BER threshold, or any other suitable quality threshold, given by the relevant ETSI deliverable, the introduction of a CW interferer level, with respect to the "wanted" signal, of:

- a) for Point-to-point equipment operating on channel spacing lower than or equal to 14 MHz:
  - +20 dB at any frequency either side of the wanted centre frequency of the RF channel from 250 % up to 500 % the channel spacing;
  - +30 dB outside 500 % the channel spacing;
- b) for Point-to-point equipment operating on channel spacing greater than 14 MHz and less than 500 MHz:
  - +30 dB at any frequency either side of the wanted centre frequency of the RF channel outside 250 % of the channel spacing;
- c) for Point-to-point equipment operating on channel spacing equal or greater than 500 MHz:
  - +30 dB at any frequency, either side of the wanted centre frequency of the RF channel, spaced more than  $\pm (150 \% \text{ of the relevant CS} + 500 \text{ MHz})$ ;
- d) for Multipoint equipment:
  - +30 dB at any frequency either side of the wanted centre frequency of the RF channel outside 550 % of the channel spacing;

shall not result in more than 1 dB degradation of the  $10^{-6}$  BER threshold.

The requirement above shall be fulfilled at any frequency in the range given in table 1.

However, systems having an integral antenna incorporating an unperturbed waveguide section, or with an antenna connection in same form, and of length equal to at least twice the cut-off wavelength, will not require receiver immunity measurement below 0,7 times the waveguide cut-off frequency; when the waveguide section is at least twenty times the cut-off wavelength measurement below waveguide cut-off frequency are not required.

**Table 1**

Fundamental receiver frequency range	CW Spurious Response frequency range	
	Lower frequency	Upper frequency (see note)
9 kHz to 100 MHz	9 kHz	1 GHz
100 MHz to 300 MHz	9 kHz	10 <sup>th</sup> harmonic
300 MHz to 600 MHz	30 MHz	3 GHz
600 MHz to 5,2 GHz	30 MHz	5 <sup>th</sup> harmonic
5,2 GHz to 13 GHz	30 MHz	26 GHz
13 GHz to 150 GHz	30 MHz	2 <sup>nd</sup> harmonic
150 GHz to 300 GHz	30 MHz	300 GHz

NOTE: The test should include the entire harmonic band and not be truncated at the precise upper frequency limit stated.

## 7.2 Receiver immunity test method

The measurement shall be referenced at the Tx/Rx common antenna port (reference points C-C' of figure 1).

According to the equipment physical construction, the test shall be carried on with the methodologies given, for P-P equipment, in ETSI EN 301 126-1 [3] and, for P-MP equipment, ETSI EN 301 126-2-1 [4], ETSI EN 301 126-2-2 [5], ETSI EN 301 126-2-3 [6], ETSI EN 301 126-2-4 [7] and ETSI EN 301 126-2-5 [8].

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# Annex A (informative): Application of CEPT/ERC Recommendation 74-01

## A.0 Introduction

The limits of the spurious domain emissions required by the present document are reported in CEPT/ERC Recommendation 74-01 [1]; however, for reader convenience, relevant parts of this recommendation are reported and commented below.

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## A.1 Frequency range of applicability

For *channel separation*  $\leq 500$  MHz, according to Recommendation ITU-R SM.329-12 [i.13] and the application to fixed service provided by Recommendation ITU-R F.1191-3 [i.15], annex 1 of CEPT/ERC Recommendation 74-01 [1] defines *unwanted emissions in the spurious domain* as any emission at frequencies which are outside the nominal carrier frequency by more than  $\pm 250$  % of the relevant *channel separation*.

However, for *channel separation*  $> 500$  MHz, according Recommendation ITU-R SM.1539-1 [i.14], annex 1 of CEPT/ERC Recommendation 74-01 [1], defines spurious emissions limits as any *unwanted emissions* at frequencies which are outside the nominal carrier frequency by more than  $\pm (500 \text{ MHz} + 150 \text{ % of the relevant channel separation expressed in MHz})$ .

Whenever a channel arrangement is not present and a CS cannot be identified, limits can still consistently apply noting that:

- Recommends 1 of CEPT/ERC Recommendation 74-01 [1], recommends that the limits: "*apply at frequencies beyond the limit of 250 % of the necessary bandwidth above and below the centre frequency of the emission*".
- According recommends 2.2 of Recommendation ITU-R F.1191-3 [i.15], the *Necessary Bandwidth* (NB) should be considered to have the same value as the *occupied bandwidth*.
- According the 1.146 of the Radio Regulations [i.12] and recommends 2.1 of Recommendation ITU-R F.1191-3 [i.15], the *occupied bandwidth* for digital fixed service systems is equal to that containing the 99 % of the emitted power.

The CEPT/ERC Recommendation 74-01 [1] requires that the limits on spurious domain emissions for radio equipment are considered here to be applicable to the range 9 kHz to 300 GHz. However, for practical measurement purpose only, the frequency range of spurious domain emissions may be restricted. As guidance for practical purposes, the measurement parameters reported in table 1 and its related notes 1 and 2 of CEPT/ERC Recommendation 74-01 [1] reprinted, for reader convenience in table A.1.

Table A.1: Abstract of CEPT/ERC Recommendation 74-01 [1]

Table 1: Frequency range for measurement of unwanted emissions		
Fundamental frequency range	Frequency range for measurements	
	Lower frequency	Upper frequency (see note)
9 kHz to 100 MHz	9 kHz	1 GHz
100 MHz to 300 MHz	9 kHz	10 <sup>th</sup> harmonic
300 MHz to 600 MHz	30 MHz	3 GHz
600 MHz to 5,2 GHz	30 MHz	5 <sup>th</sup> harmonic
5,2 GHz to 13 GHz	30 MHz	26 GHz
13 GHz to 150 GHz	30 MHz	2 <sup>nd</sup> harmonic
150 GHz to 300 GHz	30 MHz	300 GHz
NOTE: The test should include the entire harmonic band and not be truncated at the precise upper frequency limit stated.		

NOTE 1: The parameters in table 1 reflect the increasing difficulty in undertaking real tests at higher frequencies, taking into account such factors as availability and usability of suitable measurement equipment. In such cases, when systems with integral antenna would require radiated measurement, their antenna gain should be taken into account either with separate test or with appropriate theoretical calculation. In some circumstances, it may be necessary to extend the range of test frequencies in order to facilitate better protection of other services, including passive services. 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 domain emissions measurement below 0,7 times the waveguide cut-off frequency.

NOTE 2: Although measurements are outside the scope of this Recommendation, it is recognized that testing at higher frequency may not have a defined measurement uncertainty due to absence of primary references. In addition further simplifications of measuring techniques to achieve time/cost savings, while still guaranteeing with fair confidence the fulfilment of the requirement may be possible.

Regarding the limitation of measurement to frequency higher than 0,7 times the waveguide cut-off frequency mentioned in note 1, the rationale was that, with that waveguide length, lower frequencies are attenuated by more than 100 dB according the formulas:

$$\alpha_{\lambda} = 8,69 \times \sqrt{\left(\frac{2\pi}{\lambda_c}\right)^2 - \left(\frac{2\pi}{\lambda}\right)^2} \text{ [dB/m]}$$

Where:

- $\alpha_{\lambda}$  is the specific attenuation at  $\lambda$  free-space wavelength below cut-off;
- $\lambda$  and  $\lambda_c$  are the generic free-space wavelength and cut-off wavelength, respectively, expressed in meters.

According this relationship, the same amount of attenuation can be obtained at different frequency below cut-off provided that a corresponding length of cut-off waveguide is provided; therefore, the ECC, in the response to a question from EC [i.16] related to the adoption for OJEU publication of an ETSI HS, has further clarified that, to minimize the risk of exceeding the required limit, the following should be considered:

*"The roll off slope of the waveguide will depend on the length of waveguide. We consider that if the waveguide length in the actual transmitter output (power amplifier) towards the input of the antenna is greater than 20 times the cut-off wavelength, (This is equal to 92 cm in the case of WR90 with a cut-off frequency of 6.556 GHz) this is sufficient to minimize the risk. In these cases it is acceptable to perform the spurious emission measurement down to the waveguide cut-off frequency rather than 0.7 times the waveguide cut off frequency. It is important that waveguide types are specified (e.g. WR90) and have a minimum length of 20 times the cut-off wavelength. This needs to be ensured when used with these types of transmitters if measurements are not performed. It should also be understood that the length of waveguide shall be unperturbed / pure.*

*This technical approach, being a fundamental feature of waveguides below their cut off frequency, can be applicable when appropriate. Therefore, subject to the following technical conditions being ensured for any waveguide based systems ECC is satisfied with allowing deviation from the present version of ERC/ REC 74-01:*

- *That the type of waveguide in use is clearly specified.*



- *That specified waveguide has a continuously unobstructed transmission path (unperturbed/pure) and a minimum length of 20 times the waveguide cut-off wavelength in that operational mode."*

## A.2 Level limits

Table 3 of CEPT/ERC Recommendation 74-01 [1] (reprinted as table A.2 in the present document) gives the limits applicable to any fixed service station.

**Table A.2: Abstract of CEPT/ERC Recommendation 74-01 [1]**

<b>Table 3: Spurious domain emission limits for systems in the fixed service</b>			
<b>SPURIOUS DOMAIN EMISSION LIMITS FOR SYSTEMS IN THE FIXED SERVICE</b>			
<b>Reference number</b>	<b>Type of equipment</b>	<b>Frequency of the spurious domain emission <math>f</math></b>	<b>Limits: mean power or, when applicable, average power during bursts duration in the applicable reference bandwidth (see <i>recommends 4</i>)</b>
1.1.1	Fixed Service - Transmitters (all stations except those below)	$9 \text{ kHz} \leq f \leq 21,2 \text{ GHz}$ (note 1)	-50 dBm
		$21,2 \text{ GHz} < f \leq \text{FUPPER}$ (see <i>recommends 3</i> ) (note 1)	-30 dBm
1.1.2	Fixed Service - Terminal Stations (remote stations with subscriber equipment interfaces) (note 2)	$9 \text{ kHz} \leq f \leq 21,2 \text{ GHz}$ (note 1)	-40 dBm
		$21,2 \text{ GHz} < f \leq \text{FUPPER}$ (see <i>recommends 3</i> ) (note 1)	-30 dBm
1.1.3	BWA systems operating between 1 GHz and 6 GHz (all transmitting stations)	$9 \text{ kHz} \leq f \leq 1 \text{ GHz}$ (note 1)	-36 dBm
		$1 \text{ GHz} < f \leq \text{FUPPER}$ (see <i>recommends 3</i> ) (note 1)	-30 dBm
1.1.4	Fixed Service - Receivers and idle/standby transmitters, except those in reference number 1.1.5	The same limits as for the transmitters above apply	
1.1.5	BWA systems operating between 1 GHz and 6 GHz - Receivers and idle/standby transmitters	$9 \text{ kHz} \leq f \leq 1 \text{ GHz}$	-57 dBm
		$1 \text{ GHz} < f \leq \text{FUPPER}$ (see <i>recommends 11</i> )	-47 dBm
<p>NOTE 1: For digital systems, it is necessary to provide one or more steps of reference bandwidth to produce a 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 <math>\pm 250\%</math> of the relevant CS or <math>\pm (150\%</math> of the relevant CS + 500 MHz), as appropriate, the limit of spurious domain emissions are defined with reference bandwidths as detailed by Figure 1 and related Table 4, and for BWA systems operating between 1 GHz and 6 GHz by Figure 2 and the related Table 5. When "channel aggregation" (multicarrier) systems are concerned, the specific adaptation of section A1.3 of this annex applies.</p> <p>NOTE 2: Point-to-Multipoint systems used in CEPT countries foresee three kinds of stations:  - BS Base (Master) Station (referred to in Recommendation ITU-R SM.329-12);  - TS Terminal Station (referred to in Recommendation ITU-R SM.329-12);  - RS Repeater Station (not referred to in Recommendation ITU-R SM.329-12).  Repeater Stations of Point-to-multipoint systems will be considered as TS when they are intended for use only in remote stations not co-located with any other Fixed radio equipment classified as a Central station.  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 a BS.</p>			

For *noise-like emissions*, the limits are intended not to be exceeded in any elementary reference bandwidth.

When burst transmission is used, the mean power of any spurious domain emissions is measured using power averaging over the burst duration.

## A.3 Reference bandwidths

The following reference bandwidths are established by recommends 4 of the CEPT/ERC Recommendation 74-01 [1]:

- 1 kHz for spurious domain emissions falling between 9 kHz and 150 kHz;
- 10 kHz for spurious domain emissions falling between 150 kHz and 30 MHz;
- 100 kHz for spurious domain emissions falling between 30 MHz and 1 GHz;
- 1 MHz for spurious domain emissions falling above 1 GHz.

However, note 2 to recommends 4 of the CEPT/ERC Recommendation 74-01 [1] recognizes that: "Some types of equipment may use reference bandwidth values different from the above close to the carrier; these differences are quoted in the Annex for the relevant service" (see note 1).

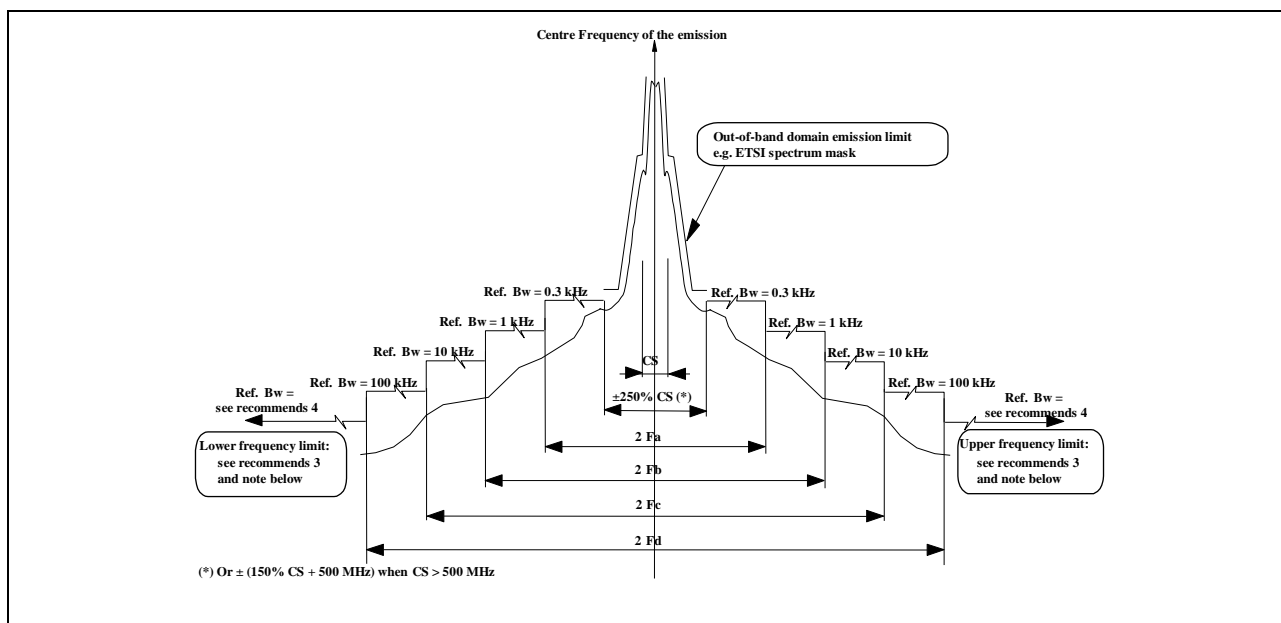
Consequently, the relevant variation of reference bandwidth that are represented by the figures, tables and relevant text in annex 1 of CEPT/ERC Recommendation 74-01 [1], which are reprinted in:

- Table A.3, applicable to all DFRS excluding:
  - a) transmitters used for BWA in bands between 1 GHz and 6 GHz;
  - b) transmitter emissions from "multiple-channels ports" of "channels-aggregation" systems operating below 21,2 GHz (see note 2).
- Table A.4, with examples of application of the recommended resolution bandwidth in table A.3.
- Table A.5, applicable to transmitters used for BWA in bands between 1 GHz and 6 GHz.
- Table A.6, applicable to transmitter emissions from "multiple-channels ports" of "channels-aggregation" systems operating below 21,2 GHz.

NOTE 1: Rationale is that, in some frequency bands and/or applications, narrow relative-band RF filters are not technically or economically feasible and it is necessary to provide one or more steps of reference bandwidth to produce suitable transition area for the emitted spectral density to manage the required limit.

NOTE 2: Definition relevant to "channels-aggregation" systems are given in ETSI EN 302 217-1 [i.8].

**Table A.3: Abstract of CEPT/ERC Recommendation 74-01 [1]:  
Reference bandwidth for all DFRS transmitters excluding those for BWA systems  
in bands between 1 GHz and 6 GHz and those emitting from multiple-channels-ports  
of channels-aggregation systems in bands below 21,2 GHz**



NOTE:  $\pm F_d$  is not applicable below 1 GHz (and recommends 3 and 4 apply)  
 $\pm F_c$  is not applicable below 30 MHz (and recommends 3 and 4 apply)  
 $\pm F_b$  is not applicable below 150 kHz (and recommends 3 and 4 apply)

**Figure 1: Specific mask for spurious domain emission limits with reference bandwidths (see Table 4)**

**Table 4: Values of  $F_a$ ,  $F_b$ ,  $F_c$  and  $F_d$  in Figure 1**

	CS		BW	BW	BW	BW
			$F_a^*$ (MHz)	$F_b^*$ (MHz)	$F_c^*$ (MHz)	$F_d^*$ (MHz)
Below 21.2 GHz (Terminal stations) (Note 1)	$0.01 \leq CS < 1$	$F_s \cong 0.006-0.8$	-	-	14	70
	$1 \leq CS < 10$	$F_s \cong 0.6-8$	-	-	28	70
	$10 \leq CS$	$6 \sim < F_s \sim >$	-	-	49 (**)	70 (**)
Below 21.2 GHz (Other stations) (Note 1) (Note 2) (Note 3)	$0.01 \leq CS < 1$	$F_s \cong 0.006-0.8$	3.5	7	14	70
	$1 \leq CS < 10$	$F_s \cong 0.6-8$	-	14 (**)	28	70
	$10 \leq CS \leq 14$	$F_s \cong 6-11$	-	-	49 (**)	70
	$14 < CS$	$10 \sim < F_s \sim >$	-	-	-	Minimum of 5 x CS and 500
Above 21.2 GHz (All stations)	$1 \leq CS < 10$	$F_s \cong 0.6-8$	-	-	-	70
	$10 \leq CS$	$6 \sim < F_s > \sim$	-	-	-	-

(\*): The frequency limits are defined with respect to the centre frequency of the emissions. For measurement purposes, the reference bandwidth given in Table 4 applies to the frequency range extending from the  $\pm 250\%$  CS (or  $\pm (150\% \text{ CS} + 500 \text{ MHz})$  as appropriate) to the frequency limit indicated, i.e. from  $250\%$  CS to  $F_a$ , then from  $F_a$  to  $F_b$ , and, from  $F_b$  to  $F_c$ , and finally from  $F_c$  to  $F_d$ .

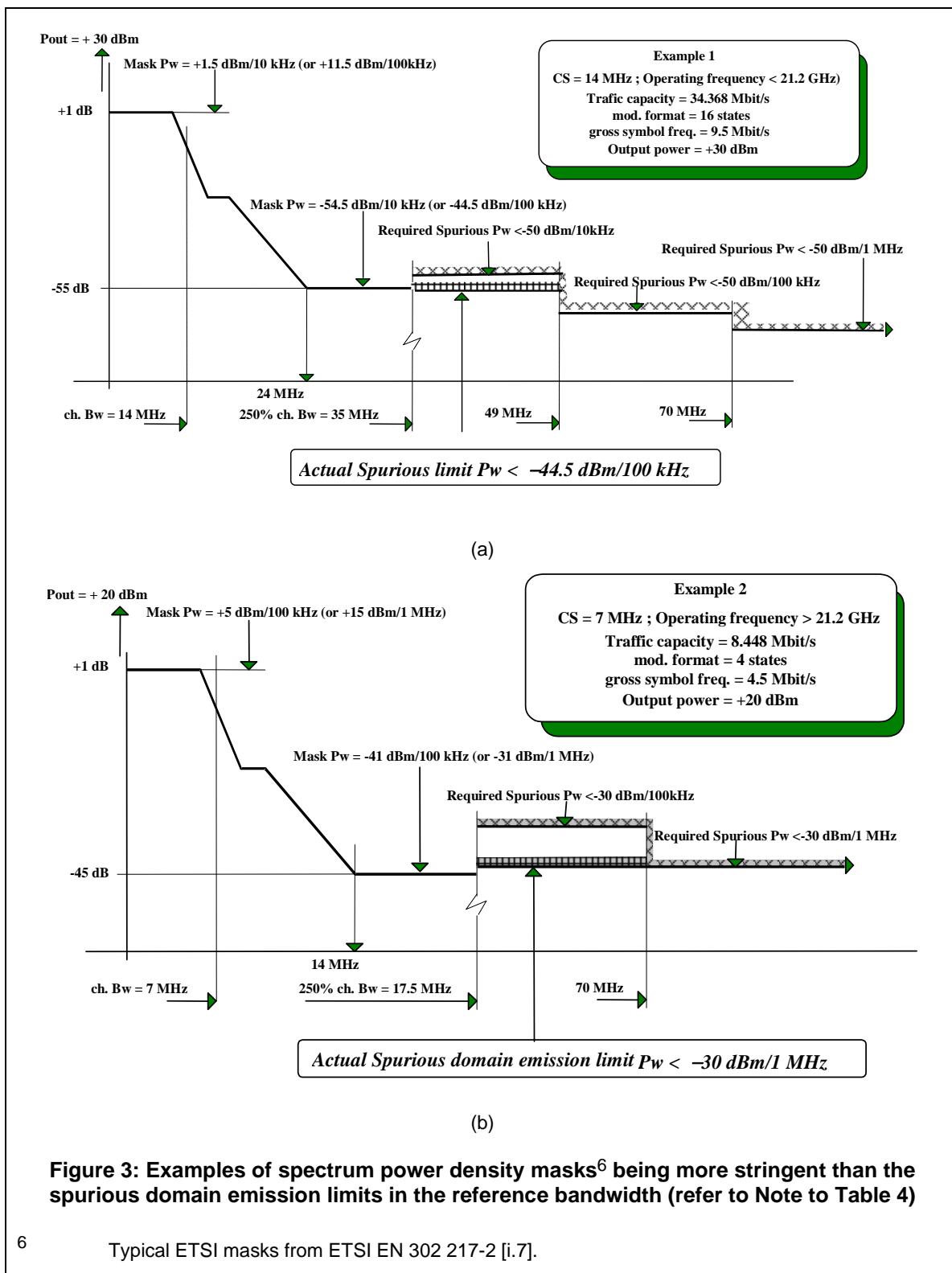
(\*\*): Not applicable for CS where the 250% point exceeds these values.

Note 1: Excluding BWA systems operating between 1 GHz and 6 GHz for which limits of Figure 2 and Table 5 apply.

Note 2: Excluding Channel aggregation (multicarrier) systems for which limits in section A.1.3 and Figure 4 apply.

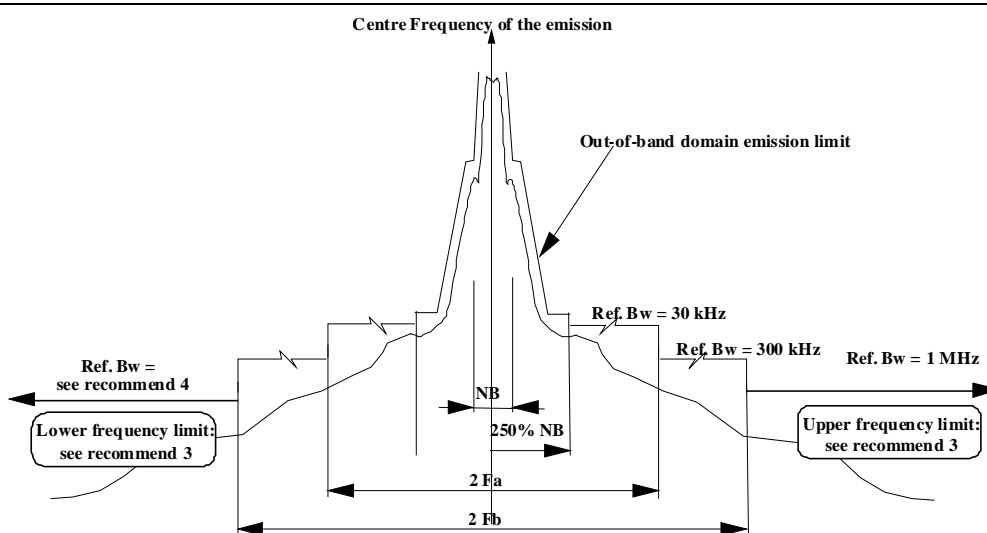
Note 3: It is recognized that the actual power density associated with the out of band domain limit provided by the ETSI mask at the boundary of  $\pm 250\%$  (or  $\pm (150\% + 500 \text{ MHz})$  as appropriate) of the relevant *Channel separation*, when evaluated in the reference bandwidth of one or more steps of Table 3, may be lower than the spurious domain emission limit mask of Figure 1 itself. In such cases, the limit of the first spurious domain emission reference bandwidth step refers to the power density equal to that evaluated with the ETSI mask in the same reference bandwidth extended to the next step (examples of this concept are shown in Figure 3).

**Table A.4: Abstract of CEPT/ERC Recommendation 74-01 [1]:  
Example of application of reference bandwidths given in Table A.3 (see note)**



NOTE: Please note that, in title of Figure 3 of the ERC Recommendation above, the reference to "Note to Table 4" should be intended as "Note 3 to Table 4"; that table and its notes are reprinted in Table A.3.

**Table A.5: Abstract of CEPT/ERC Recommendation 74-01 [1]**  
**Reference bandwidth for DFRS transmitters for BWA systems in bands between 1 GHz and 6 GHz**



**Figure 2: Specific mask for spurious domain emissions with reference bandwidths for BWA systems operating between 1 GHz and 6 GHz (see Table 5)**

**Table 5: Values of Fa and Fb in Figure 2**

<b>Fa*</b>	500 kHz or 10 times NB, whichever is the greater
<b>Fb*</b>	1 MHz or 12 times NB, whichever is the greater
(*)	The frequency limits are defined with respect to the centre frequency of the emissions. For measurement purposes, the reference bandwidth given in Figure 2 applies to the frequency range extending from the $\pm 250\%$ NB points to the first frequency limit indicated or from Fa to Fb as appropriate.

**Table A.6: Abstract of CEPT/ERC Recommendation 74-01 [1]**

**Reference bandwidth for DFRS transmitters emitting from multiple-channels-ports of channels-aggregation systems in bands below 21,2 GHz**

**A1.3.1 Boundary between the out-of-band and spurious domains for channel aggregation transmitters applicable to multiple channel antenna ports**

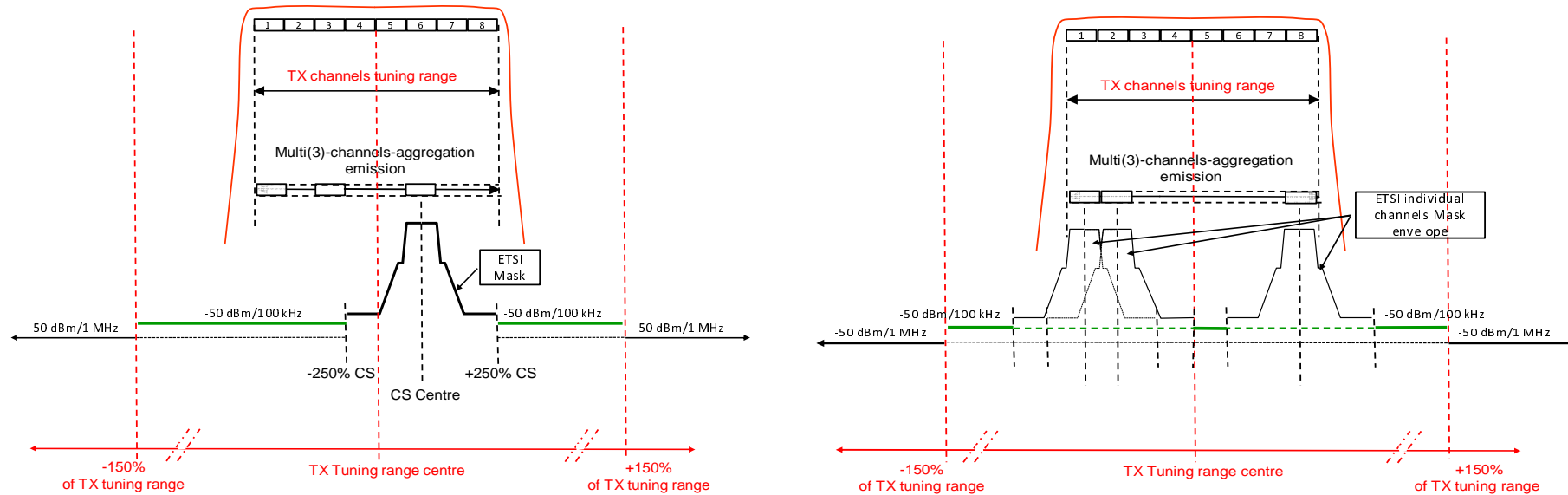
For point-to-point stations in the fixed service with channel aggregation transmitters, the transmitter operating range bandwidth is used instead of the necessary bandwidth for determining the boundary between the out-of-band and spurious domains. In the context of channel aggregation point-to-point fixed stations in the fixed service, the transmitter bandwidth is defined as the width of the frequency band covering the envelope of the transmitted channels.

**A1.3.2 Limits for channel aggregation transmitters applicable to multiple channel antenna ports**

Figure 4a) shows how the requirement to consider the tuning range bandwidth instead of NB is applied to any elementary channel of the channel aggregation system, when transmitted through the same antenna port.

The tuning range is defined as the envelope of the number of contiguous RF channels in a radio frequency channel arrangement, as defined in ECC recommendations, that can be generated by equipment, from which the operating channels can be selected. In addition, the tuning range is always a fraction (or maximum one) of the go or return sub-bands (i.e. less than half of the FS allocated band).

When all channels are activated, the emission limit shown in Figure 4a) also applies in the intermediate frequency range between the  $\pm 250\%$  of CS of each channel to the 150% of the tuning range, (see example in Figure 4b).



(a)

(b)

Figure 4: (a) Specific mask for spurious domain emissions for channel aggregation (single band/multiple channels port) systems operating below 21.2 GHz (example with 3 channels)

(b): Example with combined limits for channel aggregation (single band/multiple channels port) systems operating below 21.2 GHz (example with 3 channels)

## A.4 Detailed application of the reference bandwidths reported in table A.3

### A.4.0 Foreword

The above generic figures are detailed in next clauses for the different ranges of transmitter fundamental emissions. It is here assumed that no DFRS are practically in use in bands below 30 MHz; however, if that case exists, the same guidelines can be derived from table A.3.

### A.4.1 P-P and P-MP systems with fundamental emissions from 30 MHz to 1 GHz

a) BWr is taken equal to 0,3 kHz for:

- $0,01 \leq CS < 1$  MHz in the range from  $\pm 250$  % of CS to  $\pm 3,5$  MHz.

NOTE 1: Not applicable to TS and RS remote out-stations for which the -40 dBm limit apply.

b) BWr is taken equal to 1 kHz for:

- $0,01 \leq CS < 1$  MHz in the range from  $\pm 3,5$  MHz to  $\pm 7$  MHz; and for
- $1 \text{ MHz} \leq CS < 5,6$  MHz in the range from  $\pm 250$  % of channel spacing to  $\pm 14$  MHz.

NOTE 2: Not applicable to TS and RS remote out-stations for which the -40 dBm limit apply.

c) BWr is taken equal to 10 kHz for:

- Terminal Stations, for which the -40 dBm limit apply, for:
  - $0,01 \leq CS < 1$  MHz in the range from  $\pm 250$  % of CS to  $\pm 14$  MHz; for
  - $1 \text{ MHz} \leq CS < 10$  MHz in the range from  $\pm 250$  % of CS to  $\pm 28$  MHz; and for
  - $10 \text{ MHz} \leq CS < 19,6$  MHz in the range from  $\pm 250$  % of CS to  $\pm 49$  MHz.
- other stations for:
  - $0,01 \leq CS < 1$  MHz in the range from 7 MHz to  $\pm 14$  MHz; for
  - $1 \text{ MHz} \leq CS < 5,6$  MHz in the range from  $\pm 14$  MHz to  $\pm 28$  MHz; for
  - $5,6 \text{ MHz} \leq CS < 10$  MHz in the range from  $\pm 250$  % of CS to  $\pm 28$  MHz; and for
  - $10 \text{ MHz} \leq CS < 19,6$  MHz in the range from  $\pm 250$  % of CS to  $\pm 49$  MHz.

### A.4.2 P-P and P-MP systems with fundamental emissions from 1 GHz to 21,2 GHz

a) BWr is taken equal to 0,3 kHz for:

- $0,01 \leq CS < 1$  MHz in the range from  $\pm 250$  % of CS to  $\pm 3,5$  MHz.

NOTE 1: Not applicable to TS and RS remote out-stations for which the -40 dBm limit apply.

b) BWr is taken equal to 1 kHz for:

- $0,01 \leq CS < 1$  MHz in the range from  $\pm 3,5$  MHz to  $\pm 7$  MHz; and for

- $1 \text{ MHz} \leq \text{CS} < 5,6 \text{ MHz}$  in the range from  $\pm 250 \%$  of channel spacing to  $\pm 14 \text{ MHz}$ .

NOTE 2: Not applicable to TS and RS remote out-stations for which the -40 dBm limit apply.

c) BWr is taken equal to 10 kHz for:

- Terminal Stations for which the -40 dBm limit apply for:
  - $0,01 \leq \text{CS} < 1 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 14 \text{ MHz}$ ; for
  - $1 \text{ MHz} \leq \text{CS} < 10 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 28 \text{ MHz}$ ; and for
  - $10 \text{ MHz} \leq \text{CS} < 19,6 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 49 \text{ MHz}$ .
- Other stations for:
  - $0,01 \leq \text{CS} < 1 \text{ MHz}$  in the range from 7 MHz to  $\pm 14 \text{ MHz}$ ; for
  - $1 \text{ MHz} \leq \text{CS} < 5,6 \text{ MHz}$  in the range from  $\pm 14 \text{ MHz}$  to  $\pm 28 \text{ MHz}$ ; for
  - $5,6 \text{ MHz} \leq \text{CS} < 10 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 28 \text{ MHz}$ ; and for
  - $10 \text{ MHz} \leq \text{CS} < 19,6 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 49 \text{ MHz}$ .

d) BWr is taken equal to 100 kHz for:

- $0,01 \leq \text{CS} < 1 \text{ MHz}$  in the range from  $\pm 14 \text{ MHz}$  to  $\pm 28 \text{ MHz}$ ; for
- $1 \text{ MHz} \leq \text{CS} < 10 \text{ MHz}$  in the range from  $\pm 28 \text{ MHz}$  to  $\pm 70 \text{ MHz}$ ; for
- $10 \text{ MHz} \leq \text{CS} < 19,6 \text{ MHz}$  in the range from  $\pm 49 \text{ MHz}$  to  $\pm 70 \text{ MHz}$ ; and for
- $19,6 \text{ MHz} \leq \text{CS} \leq 100 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 500 \%$  of CS;
- $100 \text{ MHz} < \text{CS} \leq 200 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to 500 MHz;
- $200 \text{ MHz} < \text{CS}$  not applicable.

### A.4.3 P-P and P-MP systems with fundamental emissions above 21,2 GHz

BWr is taken equal to 100 kHz for:

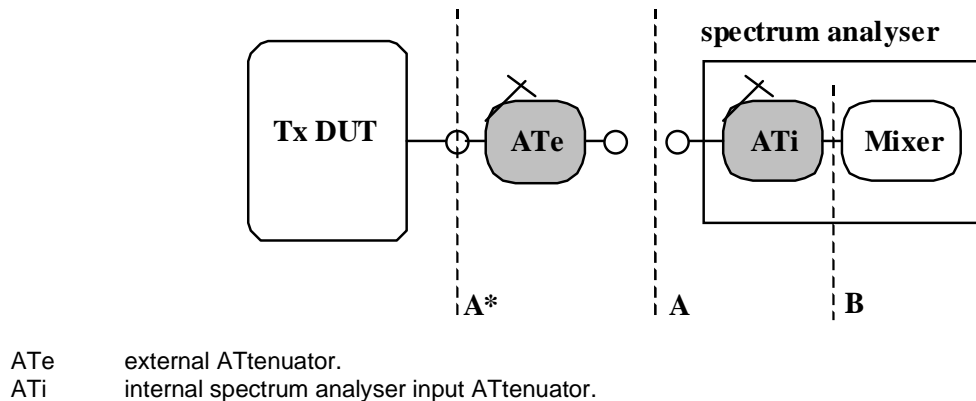
- $1 \text{ MHz} \leq \text{CS} < 10 \text{ MHz}$  in the range from  $\pm 250 \%$  of CS to  $\pm 70 \text{ MHz}$ ;
- $10 \text{ MHz} \leq \text{CS}$  not applicable.



## Annex B (informative): Measurement background

### B.1 Spectrum analyser capability

The generic set-up for emissions measurement is shown in figure B.1.



**Figure B.1: Spectrum measurement test schematic**

When digital modulation is concerned the available limits of measurement from a spectrum analyser are to be taken into account (see ETSI TR 101 036-1 [i.9]).

The following typical limitation for the spectrum analyser measurement applies depending on the characteristic of the instrument used:

- 1)  $B_{3rd}$ : Safe average input level at point B for distortion (at mixer input) (e.g. third order intermodulation reduction  $> 50$  dBc);
- 2)  $B_{Max}$ : Max. input level at point B (e.g. with 10 dB attenuation for VSWR optimization);
- 3) minimum displayed absolute level of the equivalent noise floor at A\* point:
  - with  $> 50$  dBc i.m.p. = Min displ. noise at A + (ATi + ATe);  
= Min displ. noise at A + (Pout -  $B_{3rd}$ );
  - absolute minimum (with 10 dB Att. for VSWR):  
= Min displ noise at A + (Pout -  $B_{Max}$ );  
or (whichever is greater);  
= Min displ. noise at A + 10 dB.
- 4) At high frequency (e.g. higher than about 86 GHz) direct test might not be available (see note) and external frequency converters may be needed. Their sensitivity has been estimated from available data at the time of publication of the present document.

**NOTE:** External mixers are generally available for higher frequency; this further reduce the sensitivity. However, the analyser technology at these bands might rapidly evolve as consequence of increasing market demand for millimetric band equipment.

## B.2 Application examples

The following figures show applications of the limits provided by the present document and other limits for some spectrum masks provided in ETSI EN 302 217-2 [i.7] or ETSI EN 302 217-1 [i.8].

The spectrum masks are defined to limit the out-of-band portion of the emission (i.e. within the  $\pm 250\%$  of the relevant CS or  $\pm(150\% + 500\text{ MHz})$  when applicable) together with the recommended reference bandwidth for conformance test purpose; however to visualize how the out-of-band portion of the spectral density fits to the spurious domain emissions limit at their boundary, the relative spectrum mask and the actual output power may be used to normalize the mask into a power density within the reference bandwidth where the first step of spurious domain emissions limit is defined. The normalization, is made with the formula for evaluate the power density of the topmost in-band mask level based on the power maximum power output and the *Gross Symbol Frequency* ( $G_{SF}$ ) of the equipment under test:

$$\text{Topmost mask power density [dBm/BW}_r\text{]} = P_{out} - \left( 10 \times \log \frac{G_{SF}}{BW_r} \right) + k_1$$

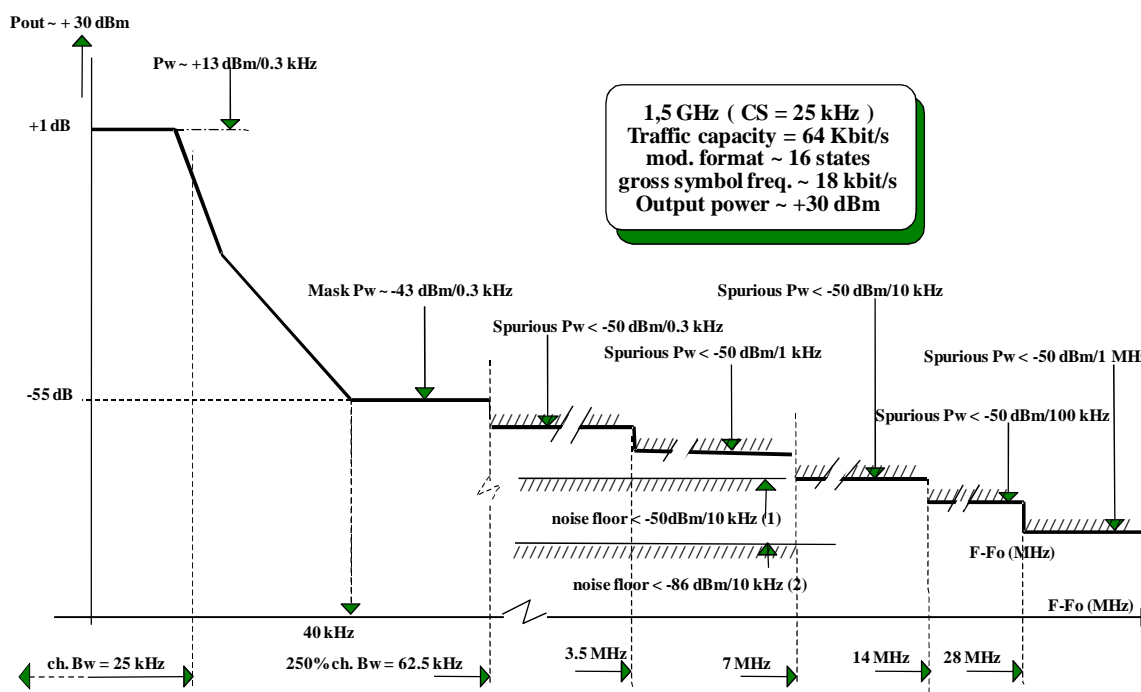
Where  $BW_r$  is the reference bandwidth of the smallest applicable step of the limit (see table A.3) and  $k_1$  is the mask topmost level provided by clause 4.2.3.2 of ETSI EN 302 217-2 [i.7].

NOTE: For discrete components of spurious domain emissions this normalization is not effective provided that their limit is independent from the reference bandwidth.

The output power of the systems (necessary to evaluate the absolute level of the signal spectral density and to set the values of the attenuators AT<sub>i</sub> and AT<sub>e</sub>) has been taken as a typical achievable level in the relevant frequency band.

In the following figures two noise floor limits of spectrum analyser are shown and marked with explanatory notes.

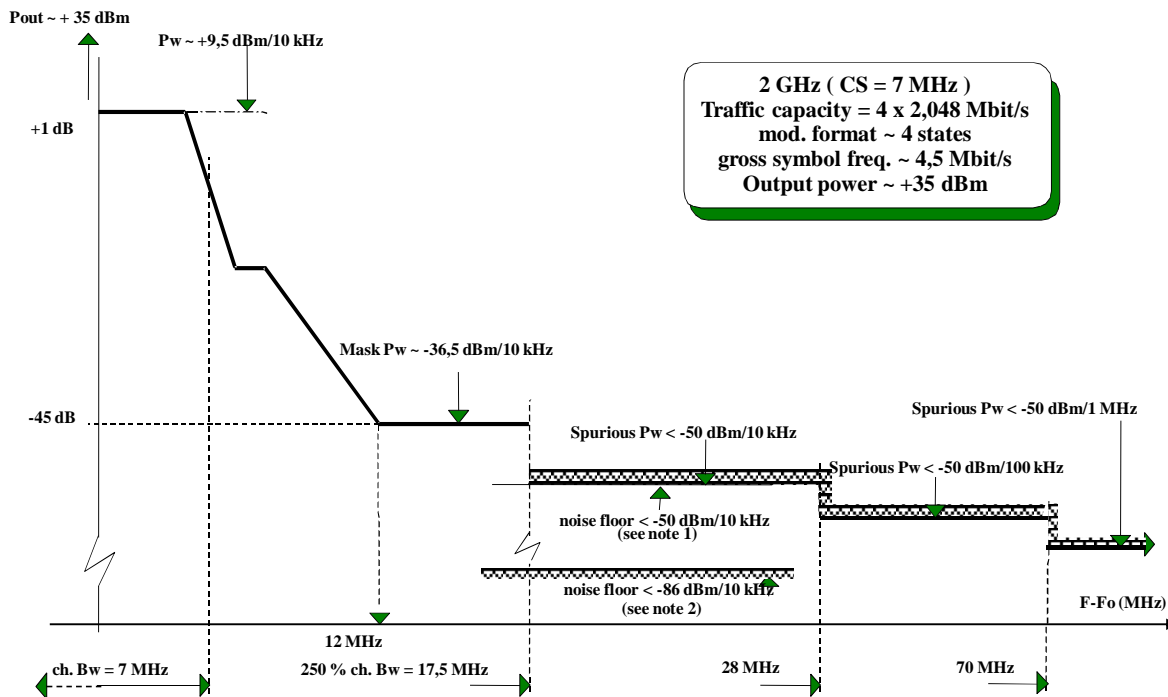
The noise floor limit with  $> 50\text{ dB}$  i.m.p. has been shown for example only, however, in practice, it may be necessary for near carrier measurement of QAM systems only, not to impair the precision. Others have to be evaluated case by case (see clause B.5.3.5 of ETSI TR 101 036-1 [i.9] for background in this field).



NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p.  $> 50\text{ dB}$ .

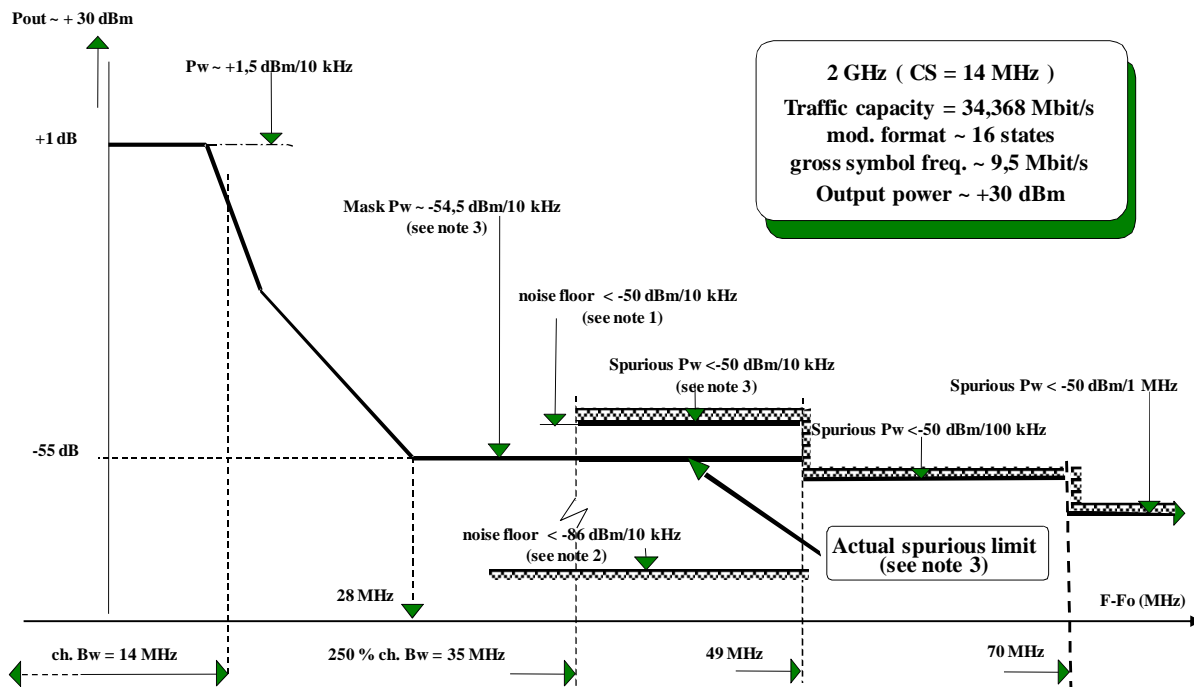
NOTE 2: Typical noise floor with maximum input level (highest dynamic range).

Figure B.2



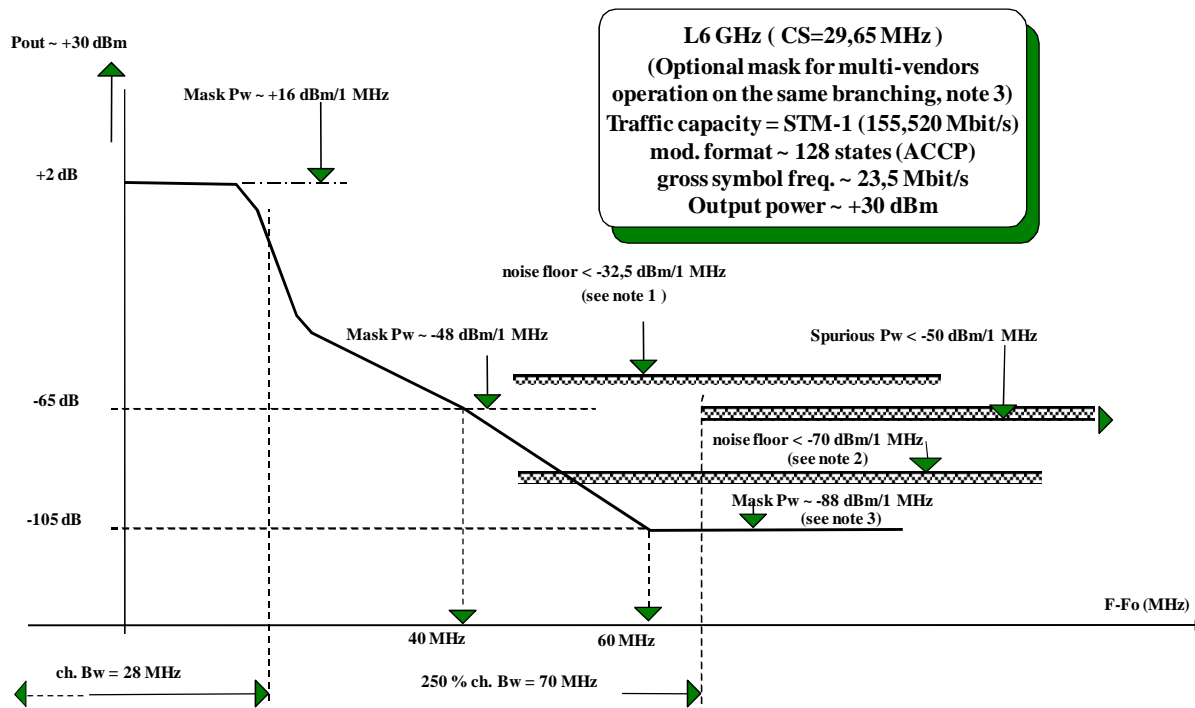
NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.  
 NOTE 2: Typical noise floor with maximum input level (highest dynamic range).

Figure B.3



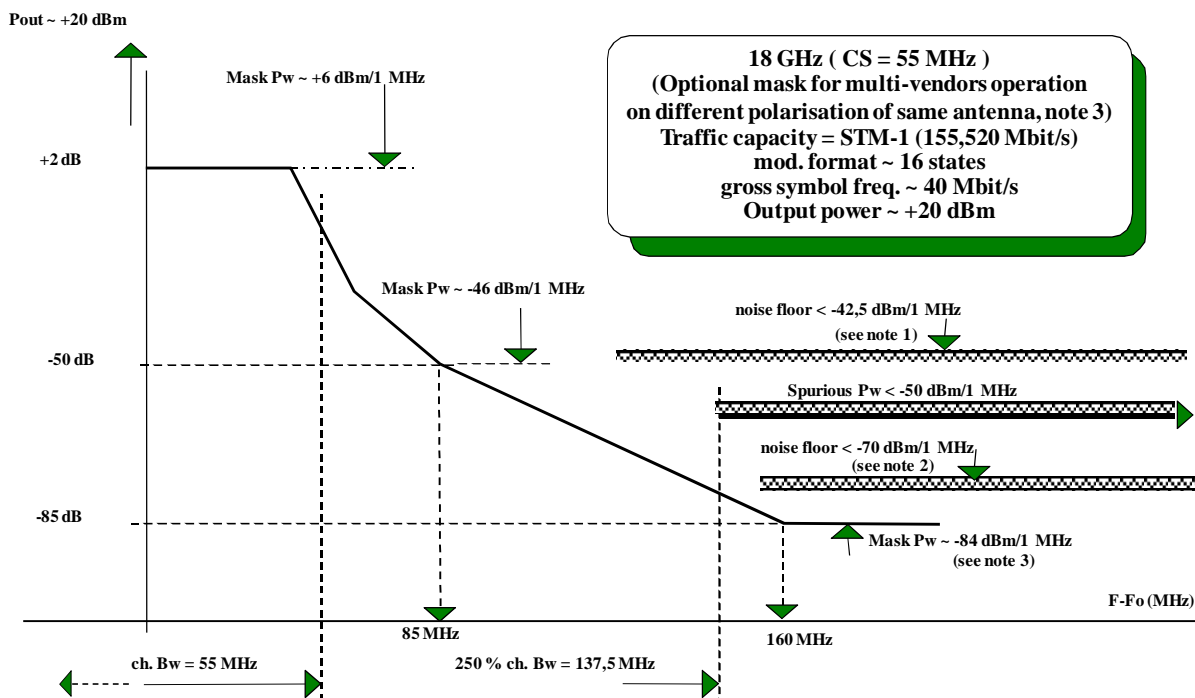
NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.  
 NOTE 2: Typical noise floor with maximum input level (highest dynamic range).  
 NOTE 3: Example of reference bandwidth step not applicable (see note 3 to table 4 of ERC/REC74-01 [1] reprinted in table A.3 of the present document).

Figure B.4



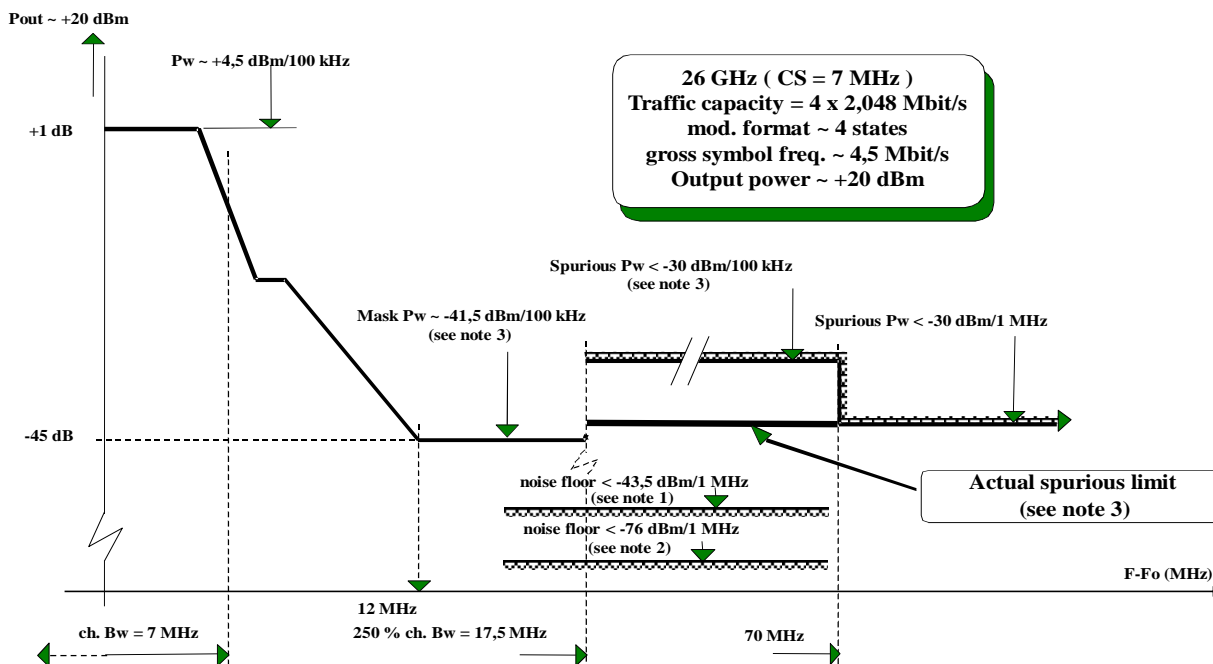
NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.  
 NOTE 2: Typical noise floor with maximum input level (highest dynamic range).  
 NOTE 3: Intra system compatibility only (see clause A.3.1 of ETSI EN 302 217-1 [i.8]).

Figure B.5



NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.  
 NOTE 2: Typical noise floor with maximum input level (highest dynamic range).  
 NOTE 3: Intra system compatibility only (see clause A.5.1 of ETSI EN 302 217-1 [i.8]).

Figure B.6

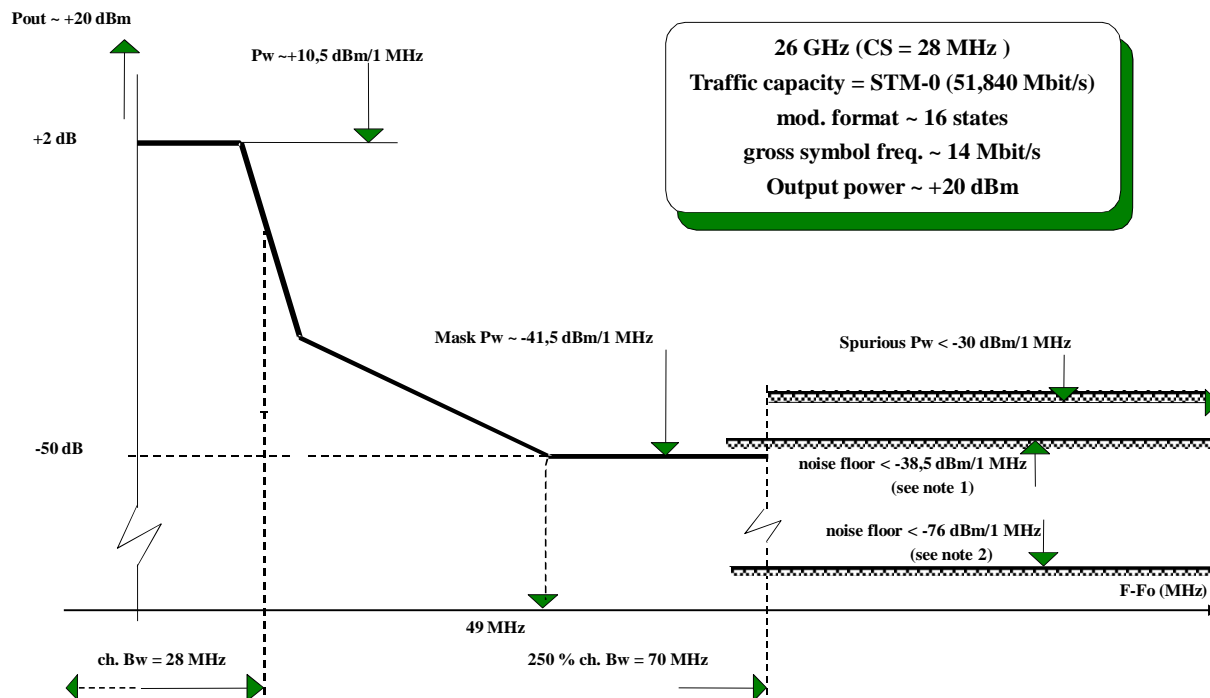


NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.

NOTE 2: Typical noise floor with maximum input level (highest dynamic range).

NOTE 3: Example of reference bandwidth step not applicable (see note 3 to table 4 of ERC/REC74-01 [1] reprinted in table A.3 of the present document).

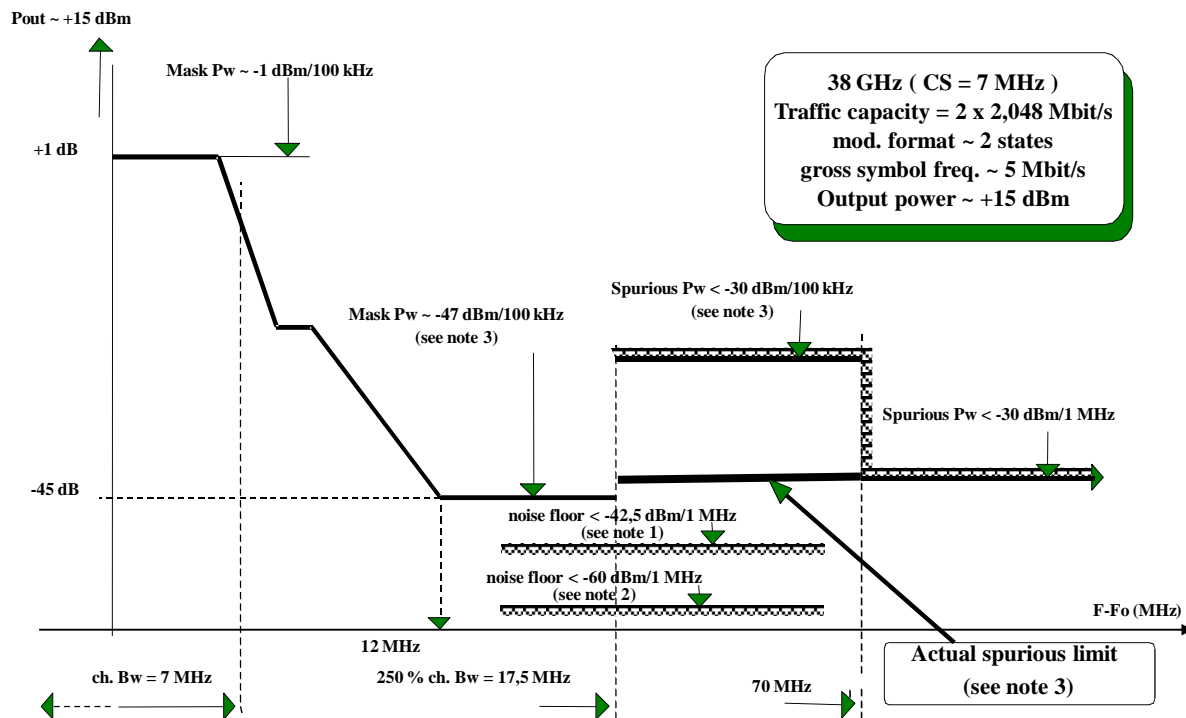
Figure B.7



NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.

NOTE 2: Typical noise floor with maximum input level (highest dynamic range).

Figure B.8

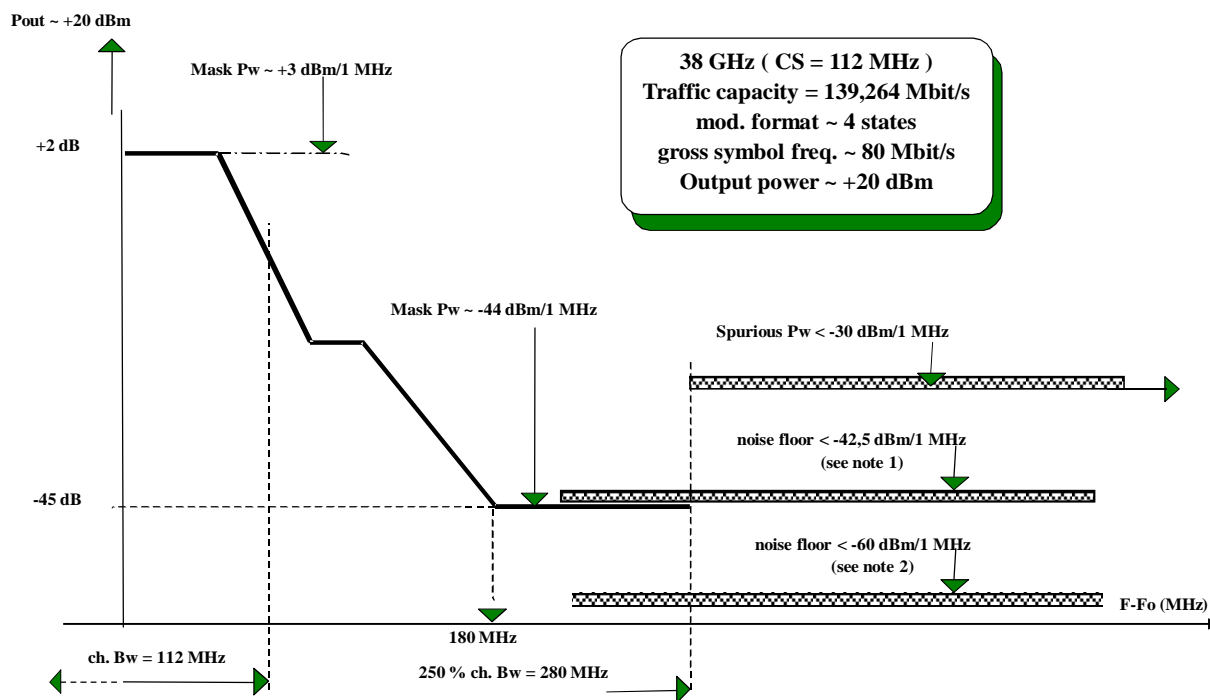


NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.

NOTE 2: Typical noise floor with maximum input level (highest dynamic range).

NOTE 3: Example of reference bandwidth step not applicable (see note 3 to table 4 of ERC/REC74-01 [1] reprinted in table A.3 of the present document).

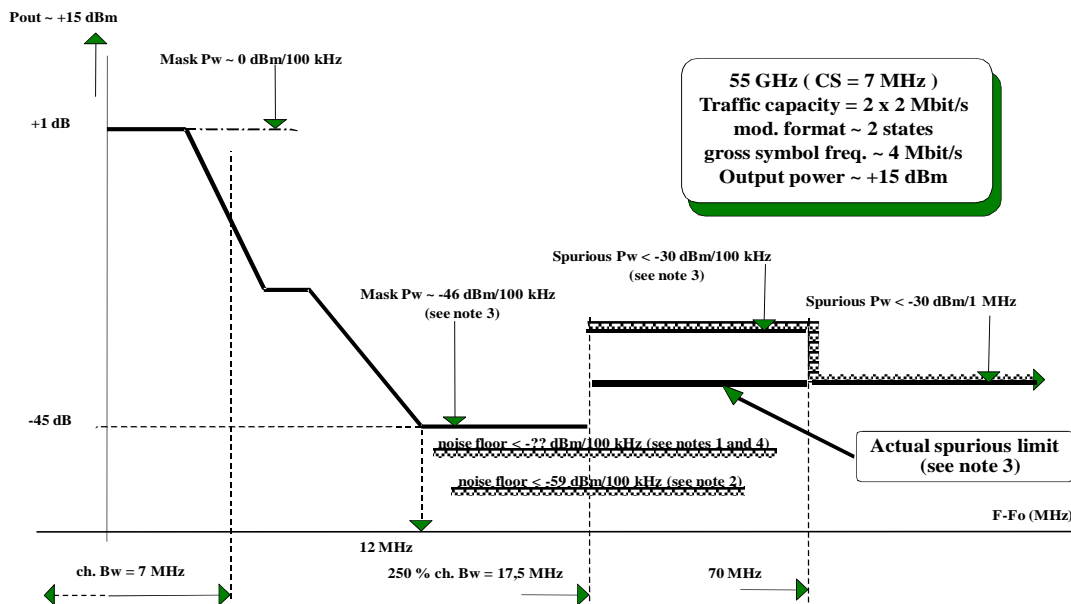
Figure B.9



NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.

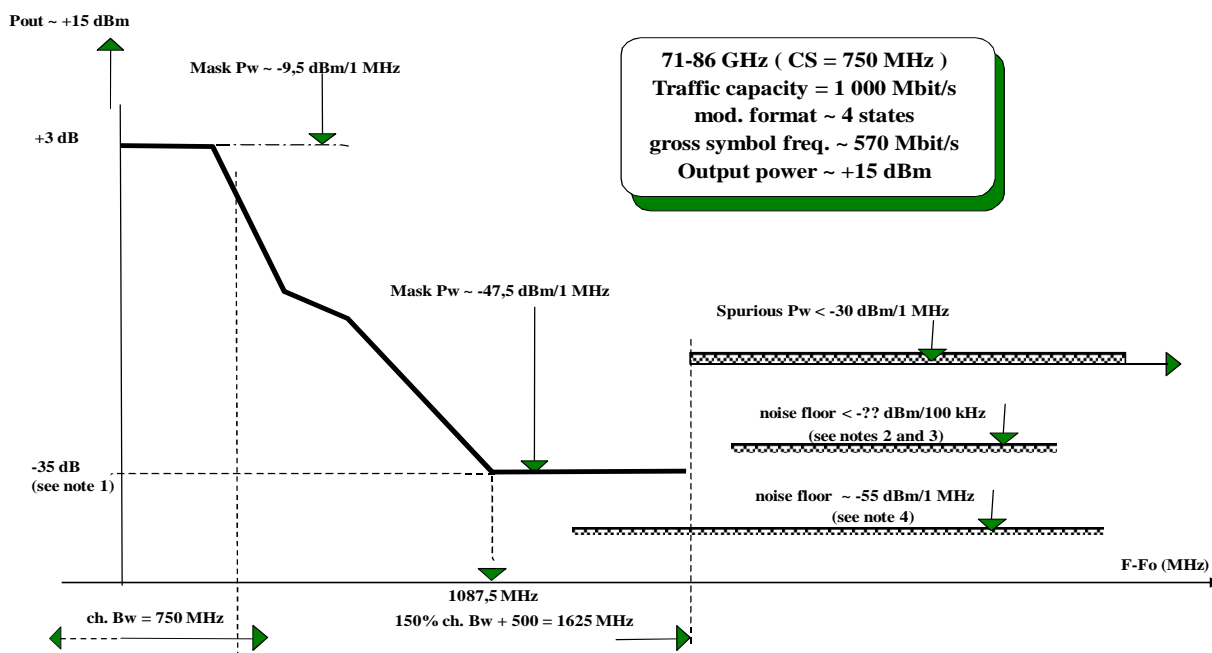
NOTE 2: Typical noise floor with maximum input level (highest dynamic range).

Figure B.10



- NOTE 1: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.
- NOTE 2: Typical noise floor with maximum input level (highest dynamic range).
- NOTE 3: Example of reference bandwidth step not applicable (see note 3 in table A.3).
- NOTE 4: The displayed noise level depends on the 3<sup>rd</sup> IM capability of the external mixer (if used).

Figure B.11



- NOTE 1: Mask floor attenuation  $\{40 - 10 \log(750/250)\}$  dB (see ETSI EN 302 217-2 [i.7]).
- NOTE 2: Typical noise floor with 3<sup>rd</sup> order i.m.p. > 50 dB.
- NOTE 3: The displayed noise level depends on the 3<sup>rd</sup> IM capability of the external mixer.
- NOTE 4: Typical noise floor with maximum input level (highest dynamic range estimated as ~70 dB).

Figure B.12

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## History

<b>Document history</b>		
V1.1.1	December 2000	Publication
V1.2.1	November 2003	Publication
V1.3.1	August 2013	Publication
V2.0.0	August 2021	EN Approval Procedure AP 20211125: 2021-08-27 to 2021-11-25
V2.1.1	November 2021	Publication